Concrete

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# California Job Shows Modern Methods of Concrete Pavement Construction

### Proportioning Aggregates by Weight or Volume—Design Mix Using Three Sizes of Coarse Aggregate—Graded Aggregates Taken from Commercial Central Batching Plant—"Weakened Plane" Joints—Joint Construction Details—Longitudinal Float Finishing

THE California Highway Department has for many years been one of the pioneers in advancing practices designed to make concrete roads better. Many of the important advances now used in other parts of the country have originated and been perfected in California. Not only has this state developed many interesting local usages, but it has also taken the practices of other parts of the country and adapted them to its work and conditions. The result of this progressiveness is concrete pavements containing numerous features of interest to concrete road builders and concrete roads which tourists long remember.

## New Methods of Proportioning

The old method of specifying concrete by arbitrary proportions has been eliminated and the requirements are now that each cubic yard of concrete shall contain a certain number of sacks of cement, depending upon the class of concrete specified. This specification has allowed contractors to estimate their quantity of cement accurately and enabled the state to make proper studies of the strengths which should be obtained.

Methods of proportioning have been closely standardized and a typical batching plant in California today is designed to proportion either by weight or volume. This arrangement lends itself readily to making corrections for moisture in sand or stone and gives close control of the strength of concrete.

## Whittier Boulevard Job

A 3.2-mile stretch of concrete pavement on Whittier Boulevard in Los Angeles County illustrates admirably some of the newest developments in California pavement construction. This section of highway extends from Michigan Avenue, Whittier, to the Orange County line. The newly constructed section lies on the principal route between Los Angeles and San Diego on the road known as the Coast Route and is a continuation of a 56-foot concrete pavement.

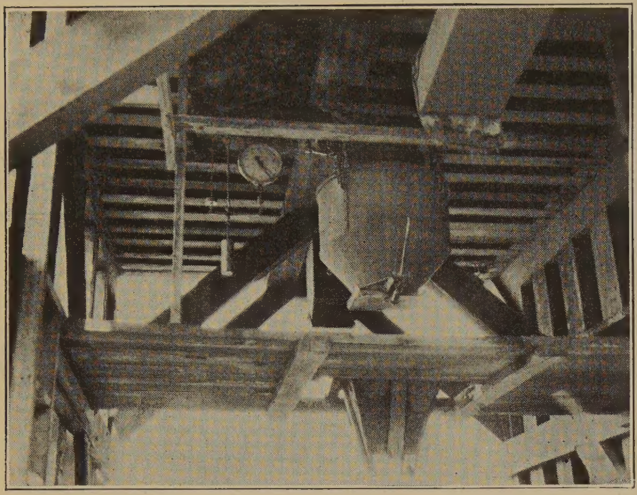
In laying the new pavement the highway department proportioned all aggregates by weight, designed a mix involving the use of three sizes of coarse aggregates, used weakened plane joints and opened the pavement to traffic in 14 days.

*A dry concrete, having a slump of from ¾ to 1 inch was used. With six bags of cement per cubic yard of concrete, strengths of 5,000 lbs. per sq. in. were developed*

## Grading

Sand and gravel were secured from the river bed of the San Gabriel River. The grading of the coarse aggregates was ordinarily good, but on this particular job there was a lack of sufficient fines. In order to meet the specifications for full grading of the materials, it became necessary to combine the No. 1 and No. 2 gravel with a proportion of smaller or what is known as "pea" gravel. These materials entering into the coarse aggregate proportion screened about as follows: The No. 1 gravel all passed a 1½-inch screen but was retained on the No. 3 screen. The No. 2 gravel all passed the 3-inch screen but was retained on a 1-inch screen. The pea gravel all passed a ¾-inch screen and was retained on the No. 10 screen.

The batches were proportioned by weight, and using



*Hoppers and scales under bins of Sycamore Canyon plant*

these combined aggregates the mix averaged about as follows:

| | |
|---|---|
| Sand | 28 per cent |
| No. 1 gravel | 19 per cent |
| No. 2 gravel | 41 per cent |
| Pea gravel | 12 per cent |
| | 100 per cent |

The weights of the materials, dry, were:

| | |
|---|---|
| Sand | 98.5 lbs. per cu. ft. |
| No. 1 gravel | 98 lbs. per cu. ft. |
| No. 2 gravel | 95 lbs. per cu. ft. |
| Pea gravel | 94.5 lbs. per cu. ft. |

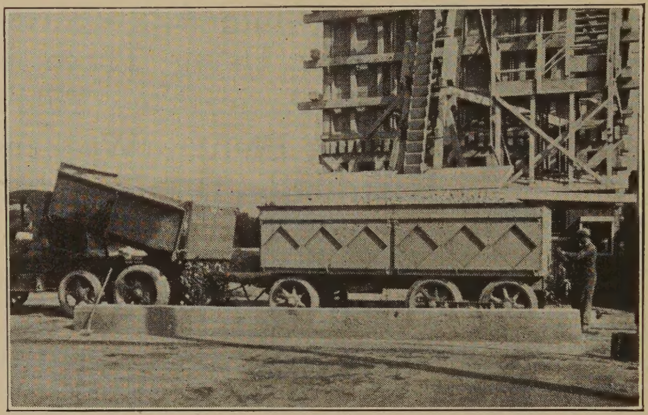
The combined weight of the mix was 108.25 lbs. per cu. ft. The weight of the water in the materials per batch was 74 pounds. On the average the sand contained 5.5 to 7 per cent of moisture, the pea gravel, 2 to 2½ per cent, and the No. 1 gravel, 1 per cent.

Throughout the job a slump of ¾ to 1 inch was maintained and with a mixture of 6 bags of cement per cubic yard, concrete averaging 5000 lbs. per sq. in. compressive strength was obtained.

### Central Proportioning Plant

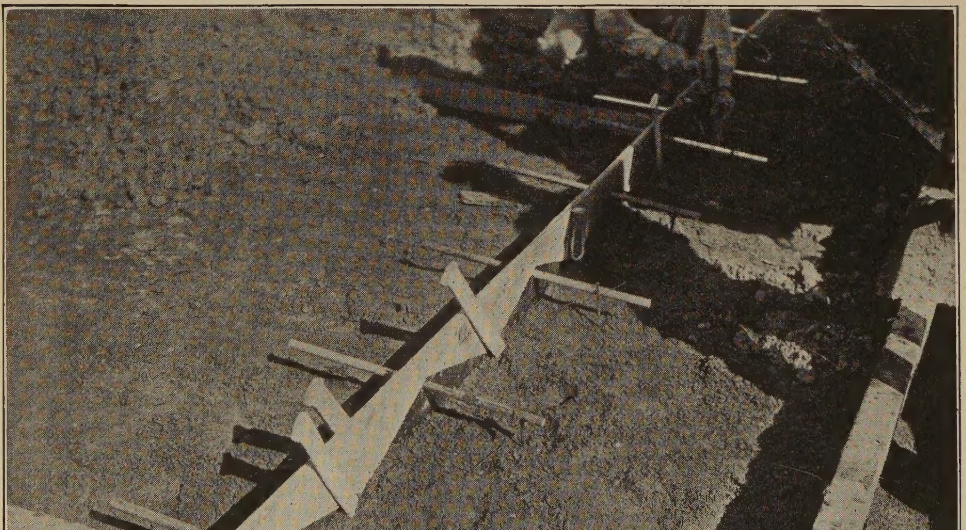
This particular job was close to Whittier. The Sycamore Canyon Gravel Company maintains a batching plant in Whittier and this plant was used to proportion the batches. A further advantage developed when it was found that this batching plant had four bins which could be used. These four bins worked in nicely with the four types of aggregates used to make a typical batch.

The batching plant was equipped with Johnson type hoppers and scales. As many as 80 batches of material per hour were turned out for this job. As an indication of the accuracy of the plant, the records showed a variation of but .03 tons in 550 tons of materials. This accuracy was checked by platform scales used to check the batch trucks.

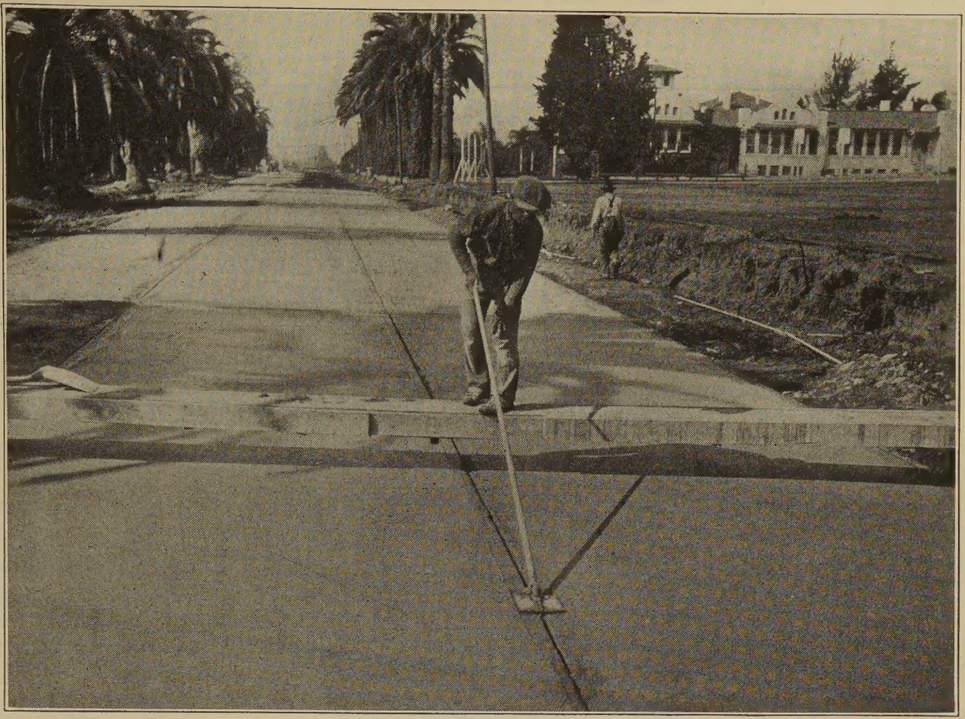


*Aggregate being unloaded and placed in the bins*

Aside from the batching, the design of the pavement also contained many interesting features. The pavement is 30

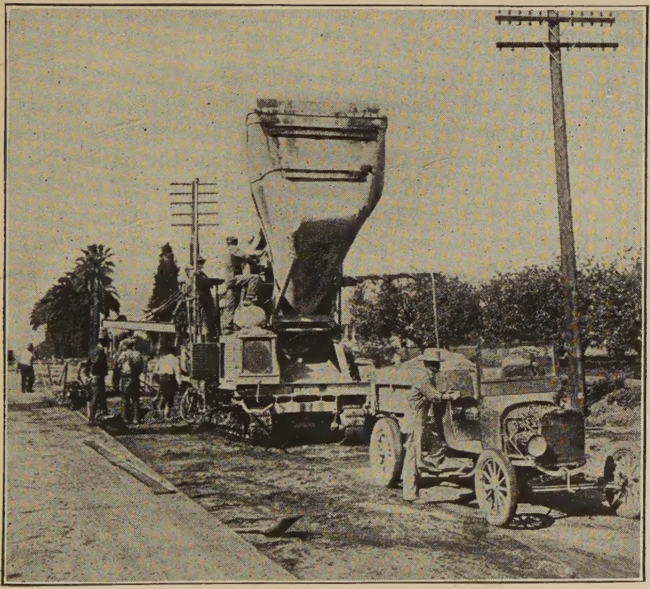


*Showing the header board with dowel bars in place for transverse expansion joints. Note the wires at the end of bars for holding the latter horizontal with the subgrade*



*A long-handled edger was used on the corners of the groove for the weakened plane longitudinal joints*

feet wide, cut by two longitudinal joints, making three 10-foot strips. The south 10-foot strip was placed first and the double 20-foot strip placed second, in one operation. This double strip was cut by a longitudinal "weakened plane" joint. Each of the three strips is 7 inches thick, flared to 9 inches at both edges. In the double 20-foot strip this thickened edge was incorporated under the "weakened plane" joint to provide additional thickness under the joint.



*Mixer and batch truck on California work*

## Weakened Plane Joints

The "weakened plane" joint has been used extensively by the California Highway Department. In constructing this type of joint, a strip of wood, usually redwood, is staked upright on the sub-grade in proper location for the slab. Concrete is placed on both sides and above the strip to the full thickness of the slab. This wood strip is ½ inch thick and 4 inches wide. On this job, with a 9-inch thickness at the joint, the wood strip cut a joint extending up into the slab 4 inches. Above the wood strip a dummy joint is cut with a cutting tool to a depth of 2 inches in the concrete. This leaves 3 inches of uncut concrete which is expected to break in a natural crack between the wood strip and the dummy joint. The groove cut for the dummy joint is edged when the first set takes place and is later filled with joint filler.

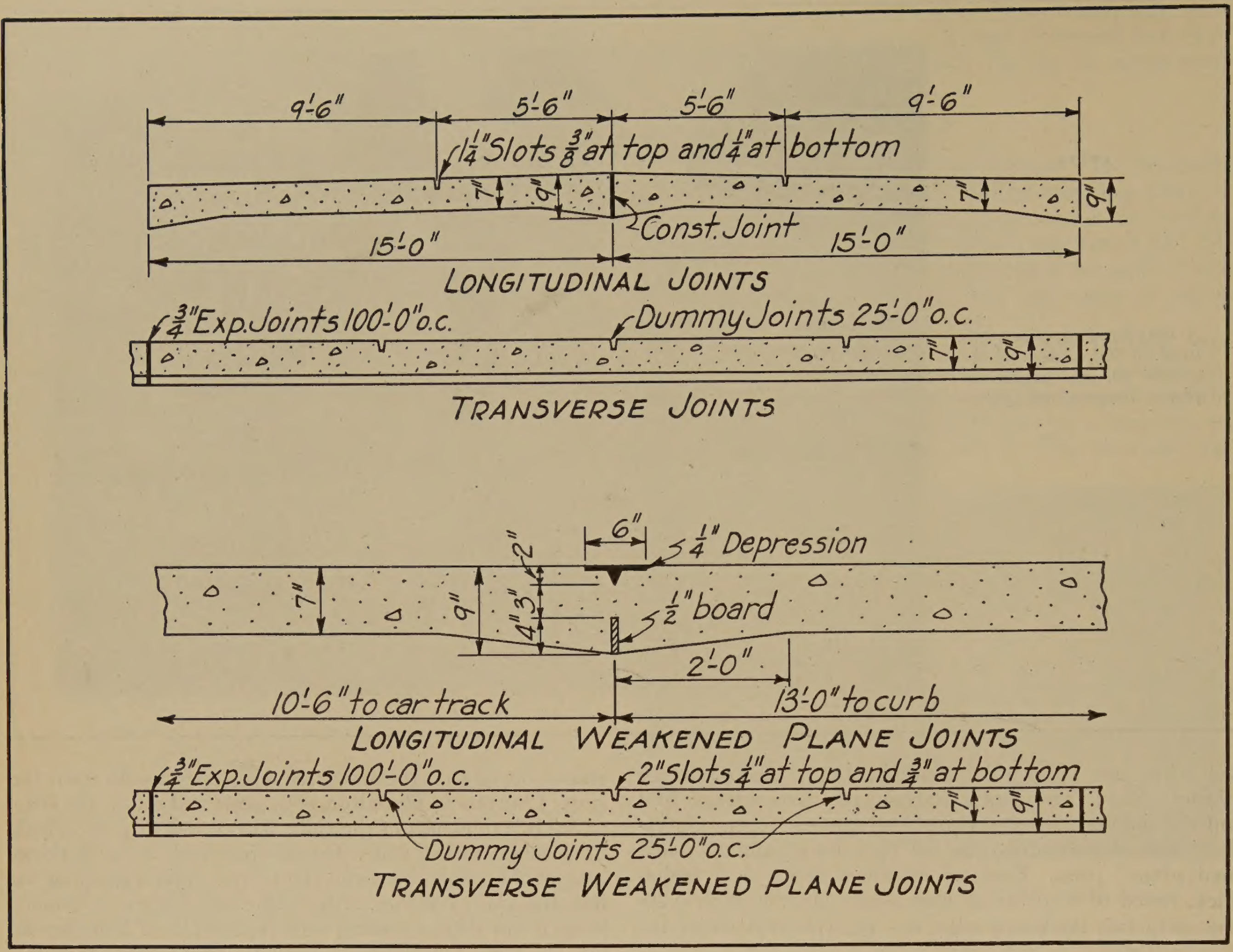
## Tools Used

There are several forms of dummy joint cutting tools employed; one is a roller cutting tool with flanged hub which prevents the knife from sinking too far, another is a T-iron fastened to a wood back or built in the form of a T-iron. To the back of the iron a pair of plow handles are fastened at the ends. The cutter is located over the wood strip with the handles and a maul is used to pound the iron into the concrete. The edger used is fastened to a long handle and is operated from bridges.

Transverse joints were built through the slab in the usual manner. Header boards were staked upright in position and the 5 dowel bars used to join adjoining slabs were held in place by the boards. The transverse joints were built at 50-foot intervals and were aligned continuously through the three slabs. Each dowel bar had a metal sleeve on one end to permit natural movement within the limits of the ½-inch expansion provided by the joint. The transverse joints were filled with premolded filler.

## Longitudinal Finishing

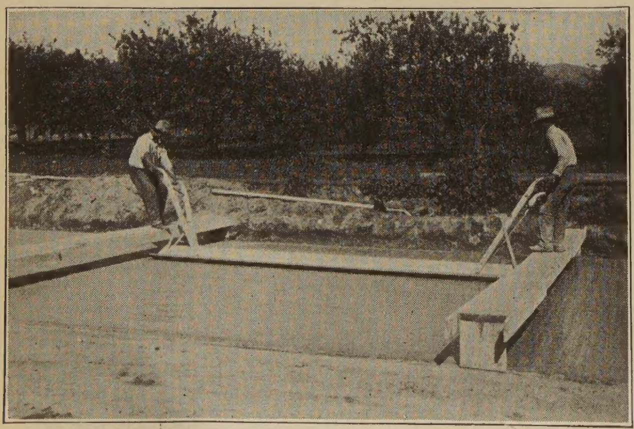
A finishing machine, longitudinal float and longitudinal belting float were used to finish the pavement. No out-of-the-ordinary finishing methods were employed. The concrete slab was then cured for 8 days by ponding. When



the temperature was over 70 degrees, the pavement sections were opened in 14 days.

### Equipment Used

The principal equipment used was a 26E Multi Foote paver, Ord finishing machine, and as many as 32 Ford batch trucks.



*Operating the longitudinal wood float. A high degree of accuracy is called for in California finishing specifications*

Unusual care in finishing is insisted upon by the California Highway Department, which accounts for the excellent and smooth-riding concrete pavements typical of all recent concrete laid in the state.

### Personnel

This particular section of concrete was awarded to George Hertz and Company, contractor, of San Bernardino. Including the incidentals, the cost approximated $175,000. The work was performed under the supervision of S. V. Cortelyou, division engineer of Division No. VII, California State Highway Commission. A. N. George was resident engineer in charge of construction.

## Metal Lath Recommendation Goes Into Effect

A sufficient number of written acceptances having been received for Simplified Practice Recommendation No. 3, on metal lath, recently revised by the industry, the Division of Simplified Practice of the Department of Commerce announces that the project is now in effect, as of January 1, 1928.

Eighty per cent of the known manufacturers, distributors and organized users must accept the recommendation in writing before it can be placed in effect by the Department of Commerce.

This recommendation was originally developed in 1923, and became effective January 1, 1924. It reduced the varieties of the commodity from 125 to 24. A factual survey recently conducted by the standing committee revealed an average degree of adherence to the recommendation of 99 per cent for 1926.

# Design of Mix for Small Size Pipe

## Some Specific Helps in Designing Concrete Mixes for Manufacturing Small Size Concrete Pipe—How to Make Pipe Water-Tight — Selecting Aggregates — Designing the Mix—Test Results

By F. R. ZAUGG
Executive Secretary, Northwest Concrete Products Association, Seattle, Wash.

DURING the past few years, much has been written about the design of concrete mixes. The information given out has been of a general nature, applying to all the various uses of concrete, and to obtain the greatest or the desired strength at least cost.

Applying the same principles to a special case, it is necessary to make some variation, omitting details here and adding details there. This needs must always occur when the fundamentals are applied to specific cases. Thus when we apply the fundamentals of good concrete to the design of a mix for a small size concrete pipe, as for example a 4-in. or 6-in. concrete pipe which has a wall thickness of about $\frac{3}{4}$-in., it is necessary to present some comparatively new or different details.

### Hydrostatic Test

First, in building a small pipe as above mentioned, to meet standard specifications, it is necessary to consider two things, crushing strength and water-tightness, or rather resistance to percolation under hydrostatic test. The crushing strength specification on small size pipe is not difficult to meet, in fact, in practically every case of numerous tests made by the writer, it has been noted that the pipe will withstand from 50 to 100 per cent more load than required by the A. S. T. M. specifications. In fact, it is very easy to make the pipe even stronger with very little consideration to grading of aggregates. But, on the other hand, it is necessary to consider water-tightness, and it has been observed that frequently a pipe of a high crushing test is liable to be quite porous, and is apt to leak freely when subjected to the hydrostatic test.

At this time we will deviate a moment to quote a sentence by a certain consulting chemist who publishes and freely distributes a small pamphlet concerning concrete pipe. He goes on to state, "It is mechanically impossible to make a concrete pipe dense enough to completely eliminate capillary percolation of ground waters." The statement is well guarded by the meaning of "capillary percolation." But if, on the other hand, a small pipe is subjected to the standard hydrostatic test as laid down in the A. S. T. M. specifications for hydrostatic test, that is, subjected to 5 lbs. water pressure for 5 minutes, 10 lbs. for 10 minutes, and 15 lbs. for 15 minutes, and the outside surface remains dry throughout the 30 minutes of the test, it would seem that the pipe successfully resists "capillary percolation" and that the above statement is not true. This very thing has been done numerous times in recent tests made in connection with the issuance of the certificate of quality to the members of this association. How then can this be accomplished?

A number of things enter into this consideration, grading of aggregates, amount of cement, amount of water, mixing time, human element in handling machine, curing, etc., all this must be carefully considered and handled properly to insure a good quality article. Slighting only one and giving excellent care to the rest of them will not necessarily counterbalance each other. In other words, the materials must be about right to start with, or much of the benefits of the careful work following will be lost, and conversely if the materials are right the remaining features must also be right to insure best results. We will therefore concern ourselves with the grading of the aggregates and the designing of the mix. The other factors are fairly well established by past experience, and in this case we shall have to assume that they are carried out properly.

### Selecting the Aggregates

Quoting from paragraph 1, Tentative Specifications for Concrete Aggregates, A. S. T. M. standards, "Fine aggregates shall consist of sand, stone, screenings or other inert materials with similar characteristics or a combination thereof having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, soft or flaky particles, shale, alkali, organic matter, loam or other deleterious substances."

Paragraph 7 for coarse aggregates is approximately the same, except that "free from injurious amounts of thin, elongated, or laminated pieces" is added.

Consequently there are three things to consider:

First: Clean materials. In the Northwest, practically all the materials are washed, and we are therefore reasonably sure that they are free from organic matter. In case of doubt, the standard sodium hydroxide (Na OH) test can be applied.

Second: Sound particles. A visual or microscopic examination will show up defective particles if they are present.

Third: The grading and proportioning of these materials that comply with paragraphs 1 and 7 mentioned above. This, then, is the subject that we will concern ourselves with.

### Aggregate Grading

Based on a number of tests of the finished product, visual examination of the same, and study of the materials used to make up the mix, etc., a number of facts have been studied and noted. First, a fineness modulus of the mixed sand and gravel should be in the neighborhood of 3.70. This was determined by actually running the sieve analysis on a number of mixers that made the best small pipe. Now, one might say that that is all there is to it. Screen the mix, get 3.70 F.M., put in the required amount of cement and water, and make the pipe. This might be all right, except that there are several other things to consider, hinging on the sieve test. Let us take for example a typical and actual sieve analysis.

SIEVE ANALYSIS

| (Col. 1) Size of Sieve, Inches | (Col. 2) Size of Opening | (Col. 3) Total Amount Coarser Than Sieve Wt., Oz. | (Col. 4) Total Amount Coarser Than Sieve Per Cent | (Col. 5) Separate Amount on Each Sieve Wt., Oz. | (Col. 6) Separate Amount on Each Sieve Per Cent |
|---|---|---|---|---|---|
| 3/8 | 0.375 | .53 | 1.12 | .53 | 1.12 |
| 4 | 0.1875 | 4.90 | 10.33 | 4.37 | 9.21 |
| 8 | 0.0937 | 15.41 | 32.49 | 10.51 | 22.16 |
| (14) 16 | 0.0469 | 27.59 | 58.17 | 12.18 | 25.68 |
| (28) 30 | 0.0232 | 37.74 | 79.57 | 10.15 | 21.40 |
| (48) 50 | 0.0117 | 43.66 | 92.05 | 5.92 | 12.48 |
| 100 | 0.0059 | 46.79 | 98.65 | 3.13 | 6.60 |
| Pan | 0.0000 | 47.43 | -------- | .64 | 1.35 |
| Total | -------- | -------- | 372.38 | 47.43 | 100.00 |
| Fin. Mod. | -------- | -------- | 3.72 | -------- | -------- |

Removing all on 3/8-inch sieve, F. M. = 3.68.

Column 1 is the different Tyler standard screen sizes. Column 2 is the size in inches of each opening in the sieve.

Columns 3 and 4 show the standard method of making the sieve analysis of cumulative total weights and percentages coarser than each sieve. You will notice that two extra columns have been added. Column 5 is the actual weight of aggregate retained on each side of the sieves and column 6 is the percentage of material by weight retained on each sieve.

From column 4 we get the regular fineness modulus figure which in this case is 3.72.

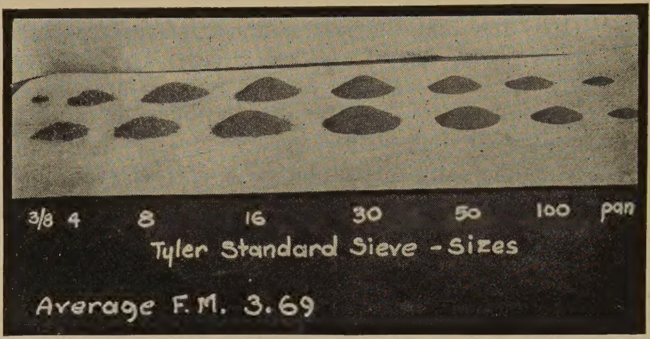
Taking the figures in column 6 as a basis, we will plot a curve of percentages against sieve sizes, as shown below.

## Sieve Sizes

A quite different curve from the regular sieve curve that we are accustomed to see in which the total coarser than each sieve is platted. This is a typical screen curve. You will notice how it rises, smoothly, beginning with the largest aggregate to about the No. 16 sieve, then falls off smoothly to a very small quantity on the pan. Thus all sieve curves for small pipe aggregates should be of this general characteristic. This is, of course, the finer and the coarser material mixed together, as for example, a sample taken from the mixer after thorough mixing but before the cement has been added.

Now a word about the dotted curve. If in plotting up these figures from column 6, table 1, a curve like the dotted arc is obtained, it is quite evident that something is wrong with the mix and that the chances are that good pipe will not result. It is evident that there is too much material retained on the No. 4 sieve and also too much on the No. 50 sieve. The No. 16 sieve has only about half enough retained thereon. The pipe manufacturer in this case must necessarily correct this condition to get good pipe. The dotted curve is from an actual sieve test from a plant whose pipe leaked considerably under the hydrostatic test. The fineness modulus of this mix was found to be 3.77.

These curves then indicate a typical good grading and a typical poor one. It might be well to mention a few other important limiting factors.

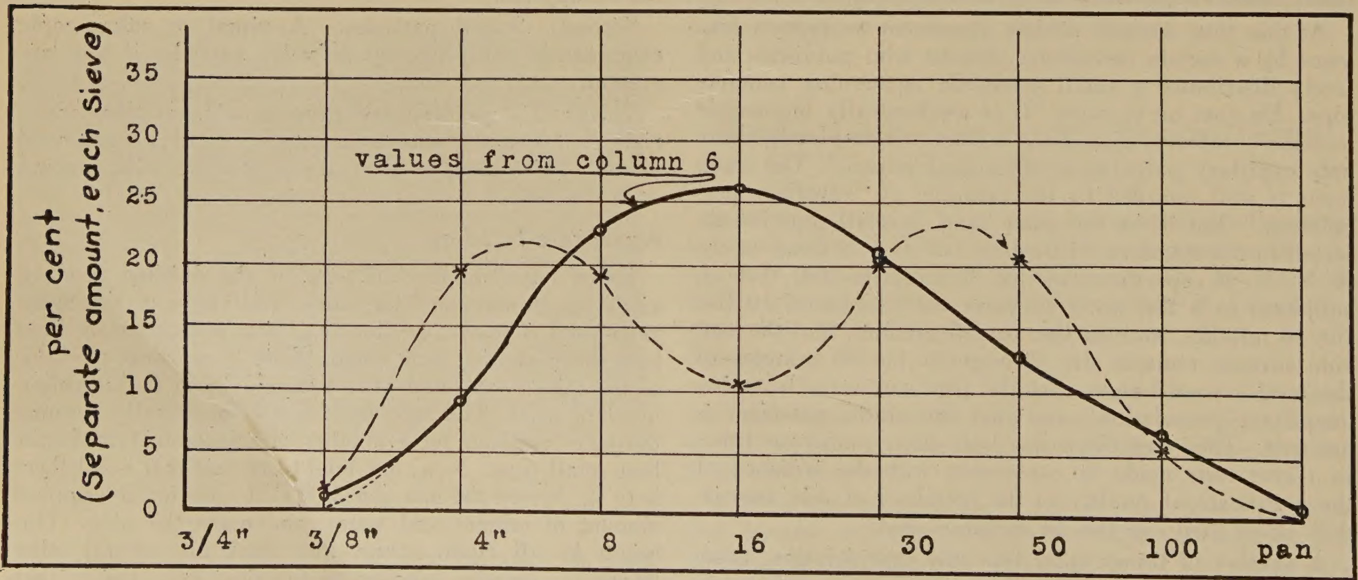


*Actual photograph of the groups of aggregates retained on each sieve*

*The size of the individual pipe is nearly proportional to the weight and percentage, thus indicating how each should appear. The upper horizontal group of piles represent the quantities as given in column 5 of the sieve analysis. The lower group is another sample with all aggregate retained on the 3/8-inch sieve removed*

## Size of Aggregate

Ordinary practice demands that the maximum size of the aggregates shall not excel one-half the minimum thickness of the wall and in some cases even less than one-half is recommended. It is quite evident that all pea gravel retained on the 3/8-inch screen is therefore too large as many of the small sizes of pipe have walls that are



*Curve showing per cent of material retained on each sieve. Solid curve shows good grading—watertight pipe. Dotted curve shows poor grading—porous pipe*

¾-inch or less in thickness. It is, therefore, necessary to remove all aggregate retained on the ⅜-inch sieve for small pipe. The fineness modulus in this case then becomes 3.68.

It is still possible for pieces too large to get through the ⅜-inch mesh, as for example, in cases where crushed material is used. Frequently these particles are thin and elongated and may even be as long as ½- to ¾-inch and still get through the screen. Paragraph seven of the A. S. T. M. specifications covers this possible defect in the aggregate for small size pipe.

Crushed aggregate also has a tendency to bridge over when several large pieces happen to be close together, thus producing a porous spot and a leak in the pipe.

It is better, therefore, ~~to~~ use only natural pea gravel consisting of rounded particles for small pipe. The crushed material can be used without difficulty in pipe with a thicker wall.

Now as to fines. A small amount should be retained on the pan. If more than 1½ per cent is retained, the mix is liable to be sticky and the removing of the green pipe from the jackets will be difficult. This will also be true if more than 7½ per cent is retained on the 100 sieve. A definite but small amount of fineness is necessary for watertightness and workability. If these are lacking, then a small amount of inert, fine admixture will help. In the above sample, it is quite evident that an admixture would be of no value.

When the aggregates are thus well graded and thoroughly mixed, the smaller particles group themselves around the larger ones and the cement paste covers each one in turn; then, by the mechanical action of the tamper, all voids are eliminated and tight pipe results. It is necessary, of course, to use a richer mix, that is, more cement for mixes made up of fine aggregates such as above described in order that all particles can be completely coated and thus properly cemented together.

The question might arise as to the proper amounts of fine gravel and sand to use in order to make up a mix with a fineness modulus of about 3.70. This can easily be done by screening both materials and obtaining the separate fineness moduli and observing the limitations for coarse and fine materials. In this case, the fineness moduli approximately are:

| | |
|---|---|
| Pea Gravel | F. M. 5.35 |
| Sand | F. M. 2.94 |
| Desired F. M. | 3.70 |

$$\text{Portion to be sand} = \frac{5.35 - 3.70}{5.35 - 2.94} = \frac{1.65}{2.41} = .685 = 68.5$$

per cent sand.

$100 - 68.5 = 31.5$ per cent gravel.

Suppose the mix is 1:2½ dry rodded then for each sack of cement use

$2\frac{1}{2} \times 68.5 = 1.7$ cu. ft. sand.

$2\frac{1}{2} \times 31.5 = .8$ cu. ft. pea gravel.

If materials are damp and loose it is then necessary to calculate the bulking of both materials and also the shrinkage factor when they are combined, and to make the necessary corrections for each. The field mix would necessarily be of greater quantity than the indicated 1:2½ mix.

### Test Results

The mix as described above has actually been used in the manufacture of small pipe. It might be interesting to know the results obtained when this pipe was subjected to the standard hydrostatic and crushing tests.

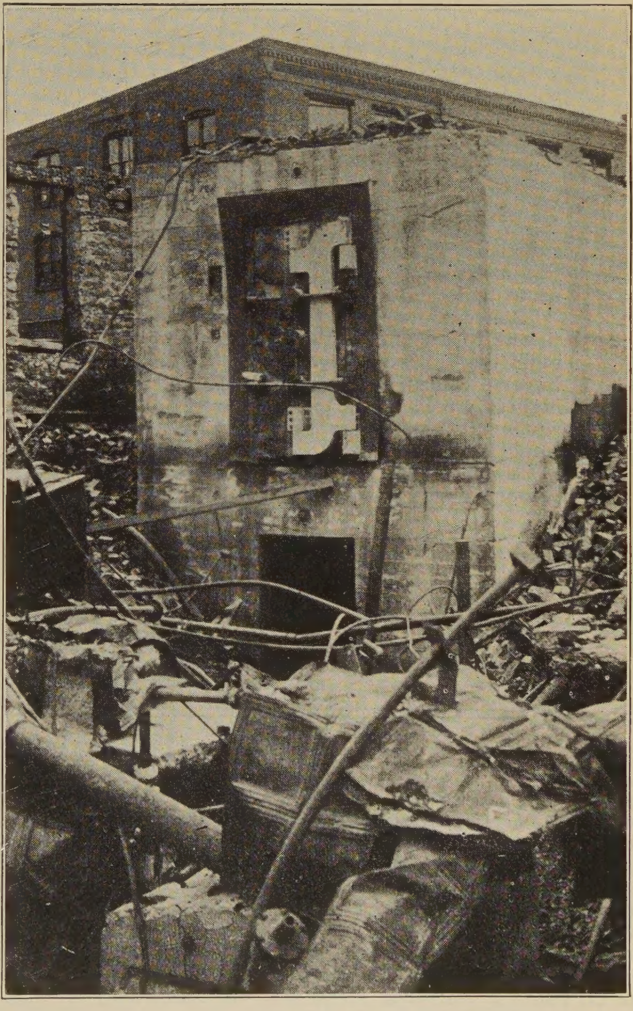
Three samples were used. The pipe at the time of the test was 33 days old and had been cured during the autumn weather which was fairly warm and moist, resulting in good curing conditions, the wall thickness being standard ¾-inch for 4-inch pipe. Under the standard A. S. T. M. test, one pipe was absolutely dry throughout the test, the other two had small sweats which later proved to be gravel pockets. Each pipe was then subjected to over 100 pounds internal hydrostatic pressure, and no failure resulted. This was maximum city water pressure available. Shortly after, the same three lengths of pipe were subjected to the crushing test by the standard three-edge bearing method and the average result was 2200 lbs. per ft. of pipe.

These tests bear out the foregoing information indicating that well graded aggregate with proper limitations will form the foundation for a good finished product.

## Concrete Safe Protects Contents in Huge City-Wide Fire

Except for a slight exterior browning, the most severely exposed bank vault in the mid-winter conflagration at Fall River, Mass., withstood the flames and thoroughly protected its contents. The vault was of concrete with the usual bank vault door.

The vault was located in a three-story frame building housing the Troy Co-Operative Bank, and was in the thickest part of the fire, according to the National Fire Protection Association.



**P. G. RILEY**
**President**

# P. G. RILEY
## GENERAL CONTRACTOR

~~701 Temple Street, Pittstown, N. J.~~

**T. G. McGOVERN**
**General Supt.**

Los Angeles

Dear Mac:

Well, whom do you think I played golf with yesterday? My old friend, Joe Brundage. Yep, he is trying to play this game of staying away from work, too.

Why in time we call it work, Mac, I don't know. Any job is a great old game, when you look back at it, but when you are doing it, it's work.

Joe and I are having a wonderful time. He, as you know, has been connected with the manufacture of concrete mixers, since the days of the old continuous mixer and sold me my first mixer. The other night he and I happened onto each other at the corner cigar store and I caught him buying some scrap chewing tobacco and he looked like I had caught him stealing a golf ball.

We heard the putt-putt-putt of a concrete mixer a night crew was using on a job we had passed and Joe tried to let on to me that it didn't mean anything in his life, and while I was itching to get on that job myself, I never let on. But right then the engine on the mixer went putt-putt-putt-blah and died. That was too much for both of us, so we went back.

The old story, wheelbarrow men sitting on the wheelbarrows, the whole job hung up and the superintendent jumping around like a California flea. Joe was happy; he had to get mixed up in it, of course. He got his white shirt all grease, cement dust on his suit and his hat dented in, but he did something to that old mixer that made it go.

After that, we sat for a long while on a pile of stone, breathing in the atmosphere around the work we both loved, listening to the music of the air hammers and the singing of the negro wheelbarrow gang, both of us looking out into the night for a long time without saying anything, and finally Joe said, "P. G., isn't it a shame that sometimes only with age comes the realization of the wisdom of taking time to fully understand the other fellow's game, who is trying to sell you and knowing completely the thing he is trying to get you to pay for instead of just buying on friendship or price, or allowing yourself to be influenced by personalities and sales talk?"

"Joe," says I, "this sounds like a repetition of an old story. Remember, you can't sell me anything now."

"Oh, shut up," snapped Joe, "you learned your lesson long ago but listen: That shut-down we just witnessed fits in with a friendly argument I had last month when I visited my old factory. They were showing me a new 10-S mixer they had just brought out and I said, 'Boys, is it as good as you can make it? Now, wait, remember I am not a buyer and there isn't one within hearing distance. Out with it.' The chief engineer said, 'You know it isn't. We would like to put this on and that on and spend so much money here and make this part this way.' And I said, 'Why don't you have the guts to do it?'

"The sales manager spoke up and said, 'If we did, contractors would not pay the price,' but I said, 'They will pay the price of costly shut-downs, which these things you have suggested would eliminate.'

"'You are right,' said the chief engineer, 'and we could eliminate every single shut-down and every expensive delay if the contractor would let us. For instance, instead of paying eleven hundred dollars for this machine, if he would pay eighteen hundred dollars or even fifteen hundred dollars he would allow us to build it for continuous operation instead of building it to meet competition.'

"Boiled down, P. G.," says Joe, "why do we have indecent plays? Why, because people buy tickets to see them. Why do we have machines that break down? Why, because the manufacturers, who build them, are merely trying to build machines to meet the competition which buyers cause to exist. If buyers would not listen to trade-ins, low prices and high-pressure sales talk but would demand the very highest priced article possible to produce, with every dollar of price represented by one hundred cents' worth of value, every manufacturer would aim toward perfect equipment instead of cheap price. They would compete among themselves to produce the best equipment instead of the lowest priced equipment."

I am just passing this along to you, Mac, as I am afraid what I said recently about watching your inventory might make you stub your toe when you buy your new mixer.

Sincerely yours,

P. G.

*NOTE*

*P. G. Riley, or P. G. as some of his friends call him, is a hard-headed, close figuring, shrewd and honest contractor who has retired from the active management of his business, leaving Anna Ryan, his faithful and efficient secretary, to manage the office and Tom McGovern, whom he calls "Mac," one of his youngest superintendents, to manage the operating end.*

*P. G. has gone to California to take it easy and like a fire horse put out to pasture spends some of his time looking longingly toward the city, yearning to get back into the strife.*

*In his letters to his young friend Mac and occasionally to Anna Ryan he secures a triple advantage. He lets off steam, causes the young people to keep him in touch with the business and is able to give bits of advice gained from his own experience and also gained by getting, as he says, "a bird's-eye view now of the business"—advice that should be of definite use to the young people now carrying on his business and maybe to other contractors who are now given the privilege of reading this one-sided correspondence.*

*As David Harum said, "There's as much human nature in some folks as there is in others if not more." And possibly P. G.'s human nature which shows in these letters will make them of interest to our readers.*

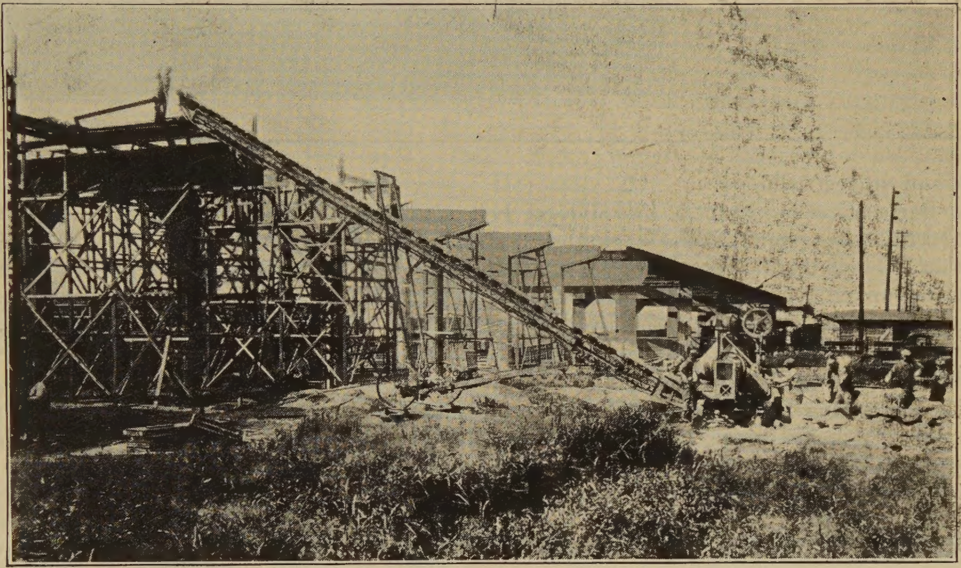
# Belt Conveyors Place Concrete

## Concrete Placed in 2700-ft. Seventh Street Viaduct at Decatur, Ill., and in California Flood Control Job Taken from Mixer to Forms on Portable Belt Conveyors—

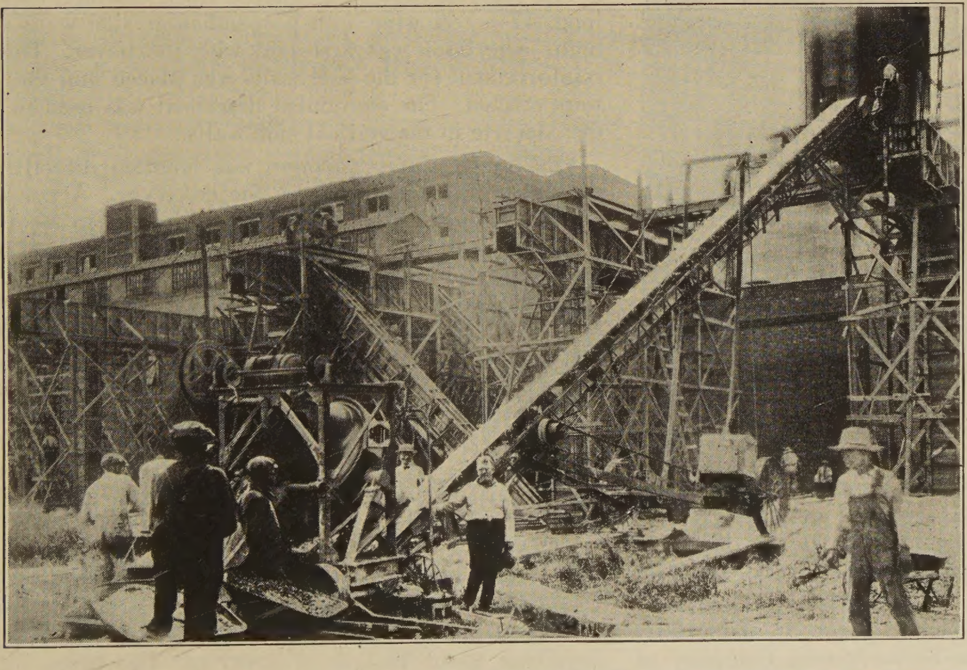
DURING the past year portable belt conveyors for transporting mixed concrete from the mixer to the forms have been used on a larger number of jobs than in previous years. Contractors have found them entirely practical both for concrete of wet consistencies and for drier mixes that are now so often used. A wide variety of plant layouts are possible when using portable conveyors and contractors have developed some ingenious arrangements that have resulted in important savings in labor costs. In the following article two jobs presenting varying conditions are described.

### The Seventh Street Viaduct

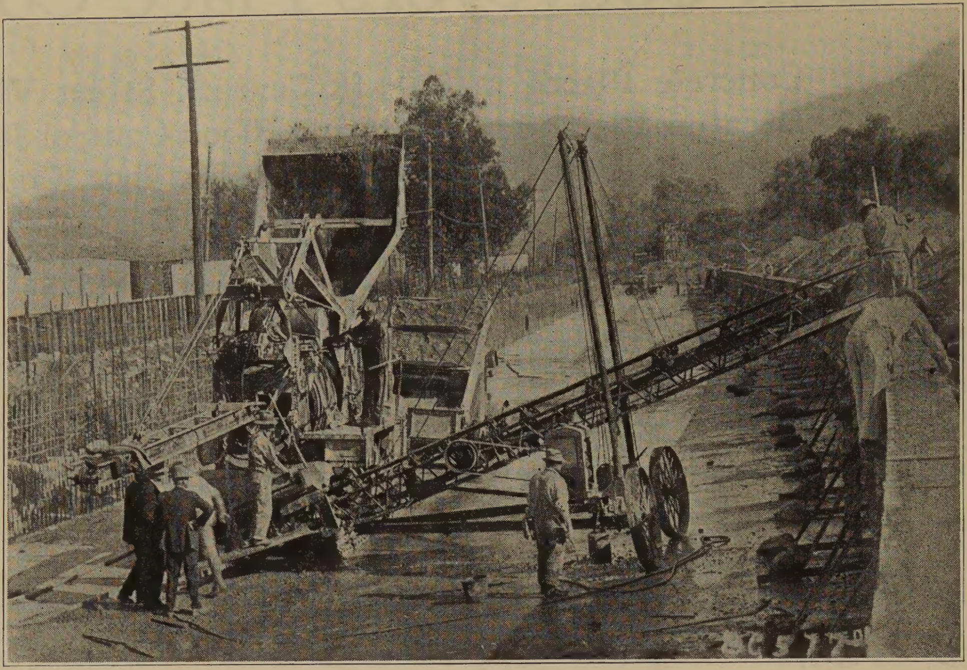
One of the interesting jobs of this kind was the construction of the Seventh Street viaduct in Decatur, Ill., by the Jones Engineering Company of Omaha, Neb. This viaduct, which reaches from one side of the city to the other, is 2700 feet long, exclusive of approaches, 30 feet



*The concrete for sixty bents like those illustrated was placed with a portable belt conveyor*



*The conveyor was tilted at an angle of 31 degrees and handled concrete having a 5½-inch slump*

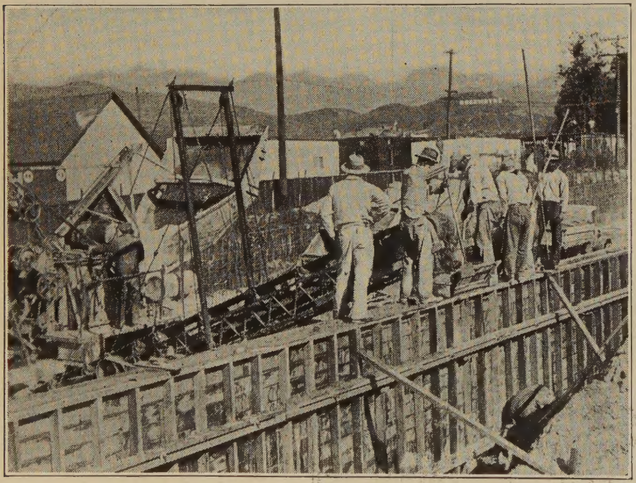


*The combination mixer and placing equipment used on the Los Angeles County flood control project. The equipment operated as a single movable unit*

high and 40 feet wide.

A Barber-Greene 24-inch by 50-foot belt conveyor carried the aggregate from the stockpiles to the mixer and another 18-inch by 60-foot conveyor was used for handling the mixed concrete. The conveyor used for handling the concrete was previously used by these contractors on a sewer job in Omaha during which the machine handled 40,000 cubic yards of sand and gravel.

In constructing the 60 pier bents, the reinforcing steel was only ¾ inches from the surface of the concrete. A plastic mix was necessary. Concrete was mixed in the proportions of 1:1½:2, using crushed rock having a maximum size of 1 inch. This yielded a concrete with a 5½-inch slump—a pliable, easily worked mixture. It was discharged onto the conveyor and taken to the discharge end from which it was dumped into the forms. The conveyor was tilted at an angle of 31 degrees.



*Tamping the concrete in the forms*

Pouring 45 tons of wet concrete per hour, using only two pieces of equipment, the Roche-Axman Company of Glendale, Calif., recently devised a different application for the belt conveyor, by which they eliminated the use of all wheelbarrows, cars, chutes, hoists, etc. The work was on the Los Angeles County Flood Control project in Verduga Canyon.

The contractors assembled a novel, self-propelled mixing and placing plant by combining a 28-E Multi-Foote paver and a Barber-Greene portable belt conveyor. The conveyor carried the mixed concrete from the mixer to the forms at a rate that called for from six to eight men for tamping. The entire mixing and placing arrangement moved along the job as a single unit. The paver was self-propelled and the wheels of the conveyor were swiveled and fastened so that the conveyor was trailed by the paver. These were the only two major items of equipment used.

The job consisted of a concrete-lined channel, 3400 feet long, 47½ feet wide with perpendicular side walls 8 feet high. The floor was first laid with the paver. Then the reinforcement for the side walls was placed and the forms were erected. The equipment described was used to place the concrete in the vertical side walls.

The 6-inch slump concrete was handled directly from the paver into the forms by the conveyor. A temporary wooden hopper was placed at the lower end to receive the concrete as it was discharged from the drum. A 6-inch discharge slot was placed in the bottom of the hopper. The edges of the slot were covered with a piece of rubber belting which extended down until it touched the belt of the conveyor. Delivery of the concrete from the hopper to the belt was controlled with a round-point, long-handled shovel at the upper end of the discharge slot. The shovel was raised or lowered to increase or decrease the flow to the conveyor. A small, bottomless box, fitting on the wall forms, received the wet concrete from the discharge end of the conveyor.

The conveyor used was a plain belt portable, 30 feet long, and placed so that it elevated the concrete 10 feet. Using this combination of mixer and placer, the contractors constructed approximately 75 feet of wall per hour, requiring about 45 tons of concrete. The entire job was completed in 32 working days.

# Comparative Tests of Crushed Stone and Gravel Concrete in New Jersey

## A Summary of the Results of Tests of Crushed Stone and Gravel Concrete as Reported by the U. S. Bureau of Public Roads—Discussions by Stanton Walker and A. T. Goldbeck

F. H. JACKSON, engineer of tests for the U. S. Bureau of Public Roads, recently published the results of some comparative tests of crushed stone and gravel concrete as used for constructing concrete roads in New Jersey. The publication of these tests was followed by discussions by Stanton Walker of the National Sand and Gravel Association and A. T. Goldbeck of the National Crushed Stone Association. Condensed reports of the tests and the discussions follow:

### The Tests

One of the reasons for conducting the tests was the claim that, under existing conditions of specifying the same proportions of cement and aggregate for concrete, regardless of the void content of the aggregate, "concrete produced from crushed stone is of a better quality than that produced from gravel due to the difference in character of these two aggregates and to the higher cement content of the stone concrete, as expressed in terms of volume of cement required to produce a unit volume of concrete."

In an effort to secure data which would furnish information as to the truth of this claim, the Bureau of Public Roads, in co-operation with the New Jersey State Highway Commission, carried out the series of tests referred to. The expressed purpose of the tests was to determine the "relative quality and economy of concrete paving mixtures in which 13 different gradations of crushed stone (traprock) and gravel were used as coarse aggregate." It was pointed out in the report that "in discussing the essential characteristics of paving concrete, it is herein assumed that insofar as strength is concerned, resistance to bending or flexure is of more significance than is resistance to crushing."

Only two aggregates were used—a gravel and a crushed traprock. Both aggregates were of satisfactory quality, and all of the materials of each type used for the various gradings came from the same source. Some of the conclusions drawn from the tests were stated as follows: That when coarse aggregates comparable in quality to those used in these tests are employed in the construction of concrete pavements in New Jersey under existing specifications:

"(a) Concrete in which crushed traprock is used as coarse aggregate will average about 12 per cent higher in flexural strength than concrete in which gravel is used as coarse aggregate.

"(b) There will be practically no difference in the crushing strength of traprock concrete and gravel concrete.

"(d) For equivalent flexural slab strengths, a pavement constructed of gravel concrete should have a depth approximately one-half inch greater than a pavement constructed of crushed traprock concrete.

"(e) The cost of the materials required for a unit volume of crushed traprock concrete will as a rule be greater than the cost of materials required for an equivalent volume of gravel concrete."

The author of the report very carefully pointed out that only two coarse aggregates were used in the tests and that the results must be considered as applicable only to the same kind of materials and produced in a similar manner.

### Mr. Goldbeck's Discussion

In the March issue of the "Crushed Stone Bulletin," A. T. Goldbeck, director of the Bureau of Engineering of the National Crushed Stone Association, comments on the tests. He explains the importance of cross-bending tests as a measure of the strength of concrete for highway construction. He says, "It is a fact that high compressive strength may be obtained even with the use of comparatively inferior coarse aggregates, but apparently the transverse strength of concrete is influenced by the characteristics of the coarse aggregates."

Using the formula: $D = \sqrt{\frac{3W^*}{S}}$

Mr. Goldbeck arrives at the following conclusions: "Let it be assumed that the modulus of rupture of the concrete is equal to the average value of the stone concrete at 28 days, namely, 570 lbs. per sq. in. The working stress would then be 285 lbs. per sq. in. The modulus of rupture of the gravel concrete was only 505 lbs. per sq. in. at 28 days and a stress of 285 lbs. per sq. in. is 56.3 per cent of this modulus of rupture, while the same stress of 285 lbs. per sq. in. is only 50 per cent of the modulus of rupture of the stone concrete. As 55 per cent of the modulus of rupture seems to approximate the deadline beyond which stress should not extend to prevent fatigue, it is well demonstrated how very important seemingly slight differences in modulus of rupture in concrete can be. The above assumed gravel concrete road having the same thickness as the stone concrete road is apt to be unsafe against cracking due to fatigue while the stone concrete road should remain uncracked.

"It is entirely logical, therefore, that one of two things be done to improve the strength of the gravel road: (1) Increase its thickness so that its bending stresses will be decreased to a value not in excess of 50 per cent of its modulus of rupture. (2) Change the proportions of the gravel concrete, requiring more cement so as to increase its modulus of rupture."

Then follows a discussion of some previous tests made at Bound Brook, N. J., from which it is deduced that "more cement is required in the gravel concrete instead of less cement as required by the time-honored arbitrary propor-

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$^*D$=Thickness of the slag at the edge.
$W$=Maximum wheel load to be applied.
$S$=One-half the modulus of rupture.

tioning method. The probabilities are, judging from the results obtained, that 10 per cent more cement is necessary in the gravel concrete of high quality than in the crushed stone concrete, and perhaps 30 per cent more cement should be used in the concrete containing poor gravel than that containing the crushed stone. The Bound Brook tests show that there is no basis for adhering to the same proportions of mortar when changing the proportions of concrete to suit different coarse aggregates, for it is shown that the stone concrete is stronger than the general concrete, even though its mortar is leaner."

**Mr. Walker's Discussion**

Stanton Walker, director, Engineering and Research division of the National Sand and Gravel Association, also discusses the report in the March issue of the "National Sand and Gravel Bulletin." He bases his criticism of the tests on two points, (1) that only one aggregate of each type was used and therefore the tests cannot be considered as applying to all stone and all gravels, and (2) that most of the aggregate gradings tested do not conform to specification limits.

"It is our belief," he says, "that the investigation is incomplete in some respects; that certain of the conclusions drawn by the author are not fully justified by the test data and that a further discussion of certain features of the investigation will be helpful. * * * This discussion is confined, for the most part, to the flexure tests, as it is only these that furnish information at variance with generally accepted facts. The fact that gravel concrete gives compressive strengths the equal of crushed stone concrete in similar proportions, even though 6 to 8 per cent less cement may be used, is well recognized and is supported by these tests. * * *

"A general criticism that may be offered of the entire investigation is that consideration is given to only one aggregate of each type. Other tests which the bureau now has under way indicate that the characteristics of the particular aggregate used may be fully as important as the type of material to which it belongs.

"Such tests would present information concerning the relative merits of crushed stone and gravel which could be applied more generally and would eliminate the possibility of too broad conclusions being drawn from these data."

Mr. Walker then presented another series of tests carried out by Abrams at the Structural Materials Research Laboratory and reported in his Bulletin II on "Flexural Strength of Plain Concrete."

"Transverse strengths were determined in this investigation for concrete made with ten crushed stones and nine gravels, as well as for certain other materials. The average of all the stones tested gave a modulus of rupture of 569 lbs. per sq. in. at three months as compared with 545 lbs. per sq. in. for the gravel. Among the crushed stones is one from Somerset, N. J., which appears to have similar characteristics to the crushed trap used in the New Jersey tests. It is interesting to note that the result of the transverse strength test of this aggregate is lower than that obtained from any of the nine gravels tested."

Commenting on his second criticism, Mr. Walker says: "While the test was designed as a study of conditions applicable to New Jersey, only two of the thirteen gradings of crushed stone and four of the gravel fall within the limits of the current specifications. In other words, 77 per cent of the tests were made with aggregates which would not be permitted in pavement construction in New Jersey because of their grading."

The article then proceeds to point out in detail which of the gradings used were acceptable in New Jersey highway work and which were not.

Mr. Walker concludes his discussion with a plea for more complete data. He says: "A more complete investigation than this would have provided information from which it could be determined what changes in cement content, proportions and gradings of aggregate, etc., would be necessary to place the two aggregates studied on an equal basis. The method of compensation by increasing the thickness of the slab is only one of several that might be applied. Proper changes in grading, proportioning or cement content would serve the same purpose, and the relative economy of these methods should be investigated.

"It is interesting to note, however, that the cost of materials required to provide the additional slab thickness of 6.1 per cent recommended in the report, is approximately the same as the cost of the additional cement required by the crushed stone. * * * When the advantages of gravel due to yield are eliminated, the outstanding advantages due to workability, ease of handling, etc., still exist and are recognized in the report."

## State Reports to Government Predict Increase in 1928 Road Construction

While it may not be great, the amount of 1928 road building will eclipse that of any previous year, according to reports received by the Bureau of Public Roads of the United States Department of Agriculture.

State and federal-aid highway system improvements will go forward during the season with a construction of more than 20,000 miles of surfaced roads and about 8,000 miles graded and drained.

The state reports also indicate that at least 240,000 miles of the total 288,000 in the state highway systems will be maintained this year under the supervision of the state highway departments, a fact which should insure the traveling public a high degree of road service.

Funds estimated as available for expenditure during the year by the state highway departments are about 25 per cent greater in total amount than similar estimates indicated at the beginning of last season. Although it is not possible, so early in the season, to anticipate closely the yield of gasoline and motor vehicle taxes and other sources of revenue it is practically certain that the funds available to all state highway departments for construction and maintenance of roads and bridges will exceed $750,000,000, and local revenues, expendable by county and local authorities, will swell the highway total to upward of $1,300,000,000.

Details are not available concerning the work to be done by county and local authorities. It is anticipated that the year's work under state supervision will result in the construction of nearly 9,000 miles of hard-surfaced pavements, upwards of 12,000 miles of less expensive surfaced roads, and 8,000 miles of road adequately graded.

## Construction Operations Follow True Spring Course

Construction operations have swung into the stretch of increased activity which they will follow throughout the summer, according to statistics just compiled by the Associated General Contractors of America. The volume of construction registered for April showed a strong increase over the March total. This increase is virtually identical with the rise which took place during the corresponding period one year ago when mid-summer operations that later were to shatter records were started.

# EDITORIAL

## High Early Strength Concrete

IT was not so long ago that concretors were concerned only with 7- and 28-day strengths of concrete. Today, in addition to these, 3-day strengths and even 24-hour strengths are becoming of increasing importance.

The advantages of high early strength for street pavements, for monolithic concrete structures and for concrete products are well known. The problem facing the concretor is not so much whether or not these higher early strengths are of economic value to him, but how he can best secure them.

That cement manufacturers are taking this new requirement seriously is shown by the steadily increasing emphasis put on early strength concrete in advertisements, folders and booklets. Another development is the marketing by cement manufacturers of special, high early strength cements.

There are two methods by which high early strength concrete may be secured. One of these is through the use of the special cements referred to. The other is by the use of standard portland cements when special methods such as richer mixes, longer mixing time, the addition of accelerating admixtures and other means are used.

The concretor must choose for himself which of these methods he will apply to his requirements. Both entail some added expense and it is for him to determine whether this added expense is justified. Then he must choose between paying a higher price for a special cement or paying the premium entailed by the methods required when standard cements are used. Both methods will, under most conditions, result in high early strengths.

It is to be expected that in any development as important as this there will be differences of opinion as to the relative merits of the two methods. Both are now being used in the field with apparent success. Gradually data will accumulate which will provide more definite records of performance. As material becomes available, it will be presented impartially in the pages of this journal.

## Know Your Costs

CONCRETE products manufacturers are hearing much lately about the value—rather the necessity—of keeping better cost records. This is a time of keen competition in the industry. It is inevitable that some plants must fall by the wayside and that these will be the plants whose managers know little or nothing of their actual production costs.

To know your costs, it is necessary to keep records. And these records must be kept systematically and accurately. Guesswork is worse than useless. To keep records that are really helpful requires some effort both in the work of installing a method and in keeping the records up to date. In the successful plant this work is considered a necessary part of operation expenses.

## Building Codes

SOME interesting facts regarding the increasing use of the water-cement ratio specification in building codes will be found in the report of the recent meeting of the Building Officials' Conference of America, appearing on another page in this issue. No less than nineteen city building codes and three standard codes of national scope have incorporated this specification as an integral part of the code. Several other codes permit full utilization of the strength of concrete as determined from tests.

Progress in this direction is doing much to straighten out the tangle caused by the great variations in building code requirements as they refer to concrete. Another beneficial effect is the increase in the quality of the concrete secured in cities operating under the new requirements. The experiences of the city of Detroit in this regard are instructive. The average strength of all tests made by the building department during 1927 was about 3700 lbs. per sq. in. as against 2900 lbs. per sq. in. in 1926. But the result of greatest importance is the fact that structural concrete testing from 1000 to 1500 lbs. per sq. in. has been virtually eliminated.

## The New Salesman

THE public today demands color. Shrewd merchandisers in many lines are seizing this new sales aid and putting it to work for them.

No longer are gas ranges chaste white or somber black. Look in any show window devoted to the sale of gas ranges and you will see them in pale green, pink, blue, orange, etc. Fountain pens, typewriters, telephones, almost everything you can think of is now sold in every shade in the spectrum. It helps sales and therefore is good business.

In the concrete industry, too, foresighted men have turned to color as a merchandising aid. Concrete block, brick, trimstone, roofing tile, floor tile, and other products are no longer the dull, drab, unattractive, though useful materials they were not so long ago. A thing can be beautiful as well as useful. It must be beautiful if the concrete products industry is to compete successfully with other materials.

# A Stockpile 32 Block High

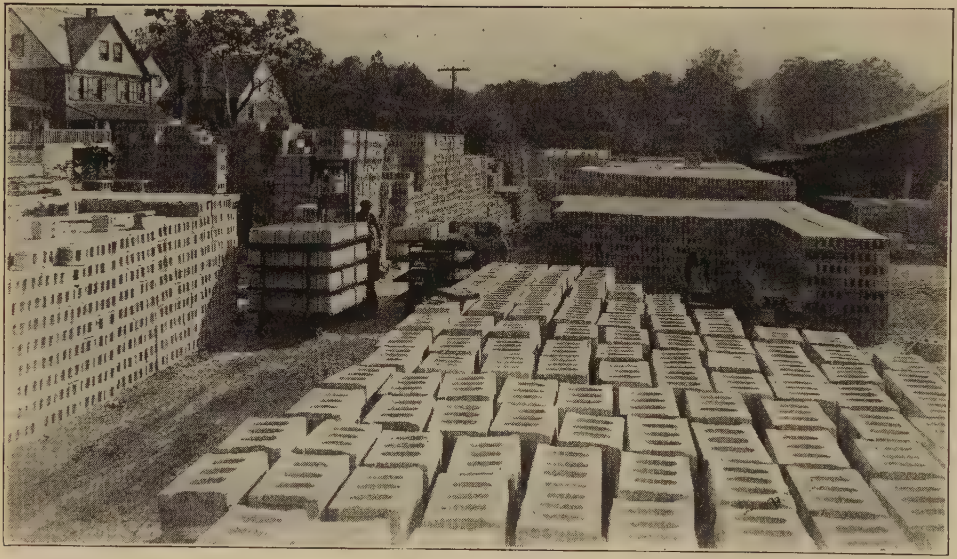
## Favorable Topography and Use of Lift Truck Make Tall Stockpile Possible

COUNT 'EM. The stockpile shown in the accompanying illustration is 32 block high. Here is a case where a Pennsylvania block manufacturer made good use of a hilly plant site. The plant is located near the center of the city in a favorable location so far as deliveries are concerned, but land was expensive and a large storage area was impossible. It was necessary, also, to make the best possible use of the limited space available for curing rooms.

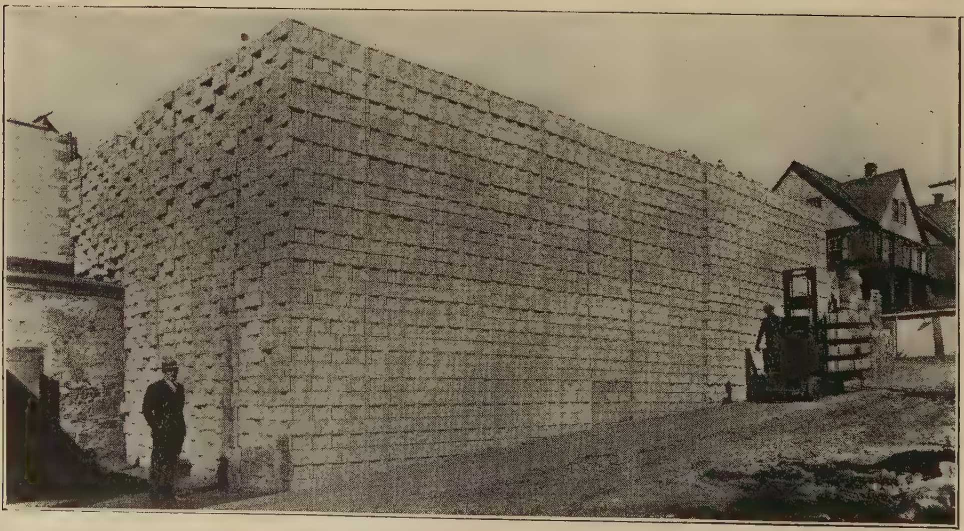
### Two Levels

By taking advantage of the differences in elevation of the stockyard and placing roadways at two levels, it was possible to build the stockpile up to 16 tiers from the lower driveway and then put another 16 tiers on top of that from the higher roadway.

The block made in this plant are cured in high tunnels capable of holding two racks of block, one on top of the other. The racks are of special design, each rack holding 4 tiers of block. When the block are molded in the machines, they are put on these racks and taken to the curing room by a Yale & Towne electrically operated lift truck. The lifting arrangement permits the placing of one rack over another in the curing rooms, thus conserving space. It also permits stockpiling 16 block high without extra labor. After the pile has been built up from the lower level driveway, the trucks take the block up inclines or ramps to the higher levels and the pile is built up.



*The outside storage yard showing the lift truck in action*



*Thirty-two block high. Count them*

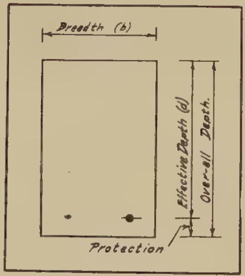
# Reinforced Concrete Design Simplified

## Chart C—Choice of Steel for Beams and Columns

By PROF. JAMES R. GRIFFITH
Armour Institute of Technology; Assoc. M., A. S. C. E.

### *Joint Committee Specifications*

$f'_c = 2{,}000$ lbs. per sq. in. $M = Kbd^2$
$f_c = 800$ lbs. per sq. in. $A_s = pbd$
$f_s = 18{,}000$ lbs. per sq. in. $K = 138.7$
$n = 15$ $p = 0.0089$
Dead-Load Weight = 150 lbs. per cu. ft.



THE writer recently was discussing this series of concrete problems with an architect. The architect felt that he did not need any additional information on the design of reinforced concrete. He remarked that he had a book giving all the necessary constants for such design. In no case is the claim made that new and unavailable information is to be published in this series. The method of presentation, with simplification as the main objective, is the justification for this series of problems.

Chart C is no exception to the above rule. Practically all texts and handbooks of reinforced concrete have tables giving bar areas. Chart C has been designed for the purpose of determining the most economical size and number of reinforcing bars for any required area, with the minimum expenditure of time and effort. A few trials will convince the reader of its superiority over any table of similar information.

### Chart C Application

Chart C contains but three scales giving the total area of steel required, the area of each bar, and the number of bars required. The various commercial bars are shown on the scale of bar areas. Usually the total area of steel is known, the problem involving the finding of the proper number and sizes to best meet the requirements. Rotating the straight edge about the point on the central scale representing the value of the total area of steel, various combinations of bar sizes and their resulting numbers can be quickly tried. As indicated, Chart C may be used in selecting steel for columns as well as beams. Since columns are to be discussed later in the series, the present discussion will be confined to beams.

In the April issue of CONCRETE, a problem was solved, requiring a total steel area ($A_s$) of 1.07 square inches. Rotating the straight edge about this value of 1.07 on the central scale of Chart C, when through a ¾-inch round bar, isopleth (1), on the right scale will be noted that more than two bars are required. This will necessitate the use of three bars. When investigating for actual stresses in the beam, the total area of steel actually used is necessary. Shifting the straight edge to go through three ¾-inch round bars, isopleth (2), on the central scale will be noted a total area of 1.3 square inches.

### General Considerations

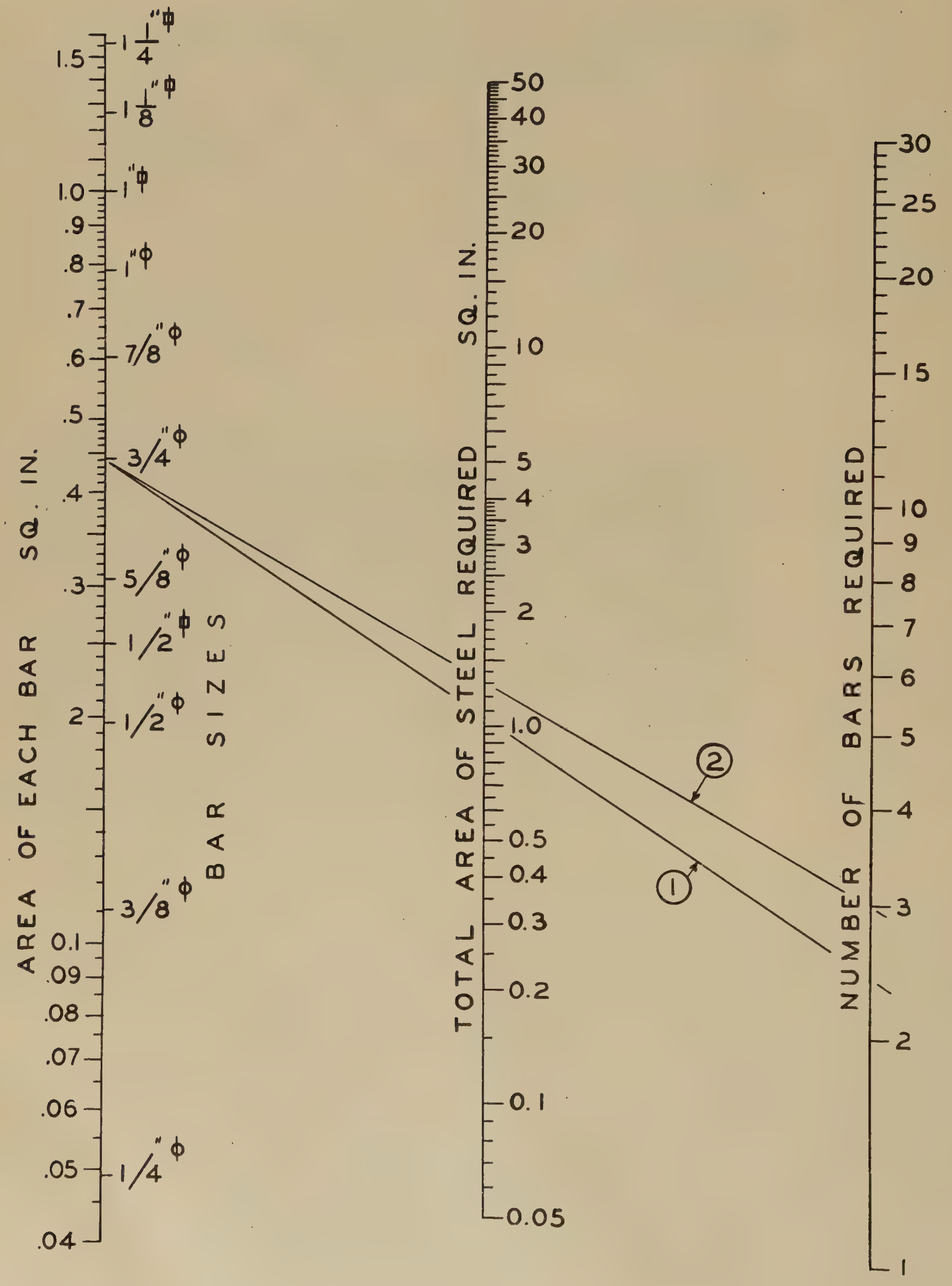
Before beginning the design of any extensive reinforced concrete structure, inquiries should be made as to the bar sizes available as well as prices. This is especially true in the smaller communities where large stocks of material are not always kept on hand. The choice of steel also involves the question of plain or deformed bars. As this question cannot be fully discussed till after shear has been taken up, it will be deferred for the time being. The higher cost of deformed bars must be balanced against the decrease in material. In one instance the purchasing department of one organization found a warehouse overstocked with ¾-inch round plain bars. Such a low unit price was given that they were used throughout the structure even when considerable excess area was necessary by the use of the one size.

Small bars are easier to bend as well as handle. The use of ¼-inch round bars, usually considered as wire, should be confined to very light construction, web reinforcing, or temperature reinforcing. It sags, is easily bent out of shape, and is exceedingly difficult to hold in place. If possible, the designer should confine his selection to as few sizes as possible. A large variety of sizes requires closer inspection to see that wrong sizes are not substituted.

The low class of labor used in placing concrete has been a retarder to its use. The placing of reinforcing steel is no exception to the rule, being done by little better than common labor. This type of labor take little pride in their work. They seem to have a very prevalent idea that as long as the correct quantities are somewhere near their right location, the specifications have been complied with. The writer was superintending the construction of one building where the designers had called for the total number of bars in each footing, neglecting to specify that half should run one way and half at right angles. Since the plans did not call for it, the foreman almost refused to place them correctly. The designer can thus do a great

CHART C

*Choice of Steel for Beams and Columns*



deal to help matters and lighten the work of the inspectors and construction engineers.

### Placing Steel

Many times, if permitted, the steel placers will lay the steel on the forms and as the concrete is poured the steel will be fished up with a hook till it is somewhere near its right location. Many designers fail to provide for chairs with which the steel can be accurately placed. The steel placers then frequently resort to rocks to hold the steel up from the forms. Then, as a last measure, the concrete contractor lays his runways on top of the steel, his laborers tramp on the steel, till the location of the reinforcing is highly questionable. The placing of steel and concrete is so haphazard at times that the engineer with construction experience gets very dubious of his design theory. Highly refined methods of design are consequently not warranted. A combination of steel may be carefully chosen to exactly fulfill the requirements of the analysis. If that steel is placed a fraction of an inch out of the way, all of the stress calculations will be off at least to some extent. In general, then, a little surplus steel is advisable.

Attention is again called to the Joint Committee Specifications, given in the April issue, governing the minimum spacing and protection of the steel. If the designer is going to specify, as he should, a maximum size of aggregate, he should choose steel that when in place will permit this maximum size of aggregate to pass through. Otherwise the steel will act as a screen, retaining the larger aggregate on top and permitting only the grout to go to the bottom of the beam. Under such circumstances the protective covering may be all right and give a good looking exterior when the forms are stripped. However, in designing concrete for a definite strength, dependence is placed on the smaller aggregate filling the voids of the larger material. Such a separation would weaken the member materially. Likewise, in the problem used for the application of Chart C, one 1⅛-inch square bar would have fulfilled the requirements of the steel area and still permitted the aggregate to pass. Such a choice would, however, concentrate too much stress in that territory of the beam and should be avoided. The steel should be well distributed across the beam.

### Construction of Chart C

The total area of steel ($A_s$) is the product of the area of each bar (a) and the number of bars (N).

$$A_s = aN$$

This equation corresponds to the general equation for logarithmic co-ordinates, $C = L^{mn/r}.R^{m(1-n)}$, Equation 7 (March issue). Equating the general to the actual exponents of the variables we have:

$$\left.\begin{aligned} \frac{mn}{r} &= 1 \\ m(1-n) &= 1 \end{aligned}\right\}$$

If the same size co-ordinates are used on the two outside scales of the nomograph, the ratio $r = 1$. Substituting this value and solving the two equations simultaneously, we get:

$$\left.\begin{aligned} n &= \tfrac{1}{2} \\ m &= 2 \end{aligned}\right\}$$

This will indicate that the central scale must be half way between the other two scales and have co-ordinates one-half the size of those used on the two outside scales.

## A. S. T. M. Sessions to Deal with Current Concrete Problems

The thirteenth and fourteenth sessions of the coming annual meeting of the American Society for Testing Materials will bear on the subjects of concrete, cement, lime and drainage pipe. The meeting will be held on June 25th to 29th at Chalfonte-Haddon Hall at Atlantic City.

The report of Committee C-1, on cement, will discuss the non-agreement of results of the chemical, fineness, consistency, time of set and strength tests made in a period of two years on 32 cements by 47 laboratories.

Then follow in order on the program papers entitled "A Plastic Mortar Compression Test for Cement," describing a test of mortar gaged to the same water-cement ratio as the corresponding concrete, and "Volume Changes of Portland Cement as Affected by Chemical Composition and Aging," by Alfred H. White.

### Action of Sulphate Water

D. G. Miller will present a paper, "Resistance of Portland Cement Concrete to the Action of Sulphate Waters as Influenced by the Cement."

Concrete load-bearing pipe will be the subject of a discussion to be introduced by W. J. Schlick. The three national standards for pipe tests will be taken up. At this session also the chairman of the joint committee will report on concrete culvert pipe.

### Second Concrete Session

A report to be made by Cloyd M. Chapman, chairman of Committee C-9, on concrete and concrete aggregates, includes a statement of procedure for design of concrete mixtures by the water-cement ratio method. Revisions of several tentative standards and a new test method are also included.

"The Determination of the Workability of Concrete," is the title of a paper prepared by W. F. Purrington and H. C. Loring, to be presented before the session.

A discussion by G. A. Smith and George Conahey, "The Measurement of Workability of Concrete," will describe an improved penetration apparatus which gives an index of the workability agreeing with field observations indicating consistent differences due to variations in the mix and other factors.

Permeability of concrete is the subject of a paper by Ira L. Collier describing the apparatus employed for testing permeability on specimens 9 inches in diameter and 8 inches high under air pressures up to 150 lbs. per sq. in.

C. H. Scholer will present a paper on "Some Accelerated Freezing and Thawing Tests on Concrete."

Other papers and discussions to be presented are "Tension, Compression and Transverse Tests of Plain Concrete," by H. F. Gonnerman and E. C. Shuman; "The Effect of Several Mechanical Features of Testing on Determination of Flexural Strength of Plain Concrete," by T. F. Willis, and another by L. N. Edwards and H. L. Greenleaf, entitled "Experimental Tests of Concrete-Steel Bond."

The opening day of the meeting is reserved for committee meetings and registration, the opening session being held on Tuesday afternoon at 2 o'clock.

In most cases, simultaneous technical sessions are necessary, but the opening session and that on concrete, the latter on June 29th, as well as two others on technical subjects, will be single. In addition, one session, on Wednesday afternoon, has been arranged to be devoted exclusively to the Edgar Marburg lecture and the award of the Charles B. Dudley medal. The presidential address and the report of the executive committee will take place at the Wednesday evening session.

# *Practical Kinks from the Job*

## Chicago Mixer Crew Makes Speed Record

In the course of erecting the Milliners' Building in Chicago, on which the Dilks Construction Company was the general contractor, the H. A. Dailey Company, subcontractors for the concrete and monolithic work, installed a mixing outfit consisting chiefly of a ¾-yard Marsh-Capron mixer operated by a crew of four men. Working with apparent ease these men mixed the 240 yards of concrete required for each floor in 8 hours, and in 4 weeks time, 13 floors and the basement were completed, ready for plastering. All the plumbing and electrical connections had to be in place before the concrete was poured, so that every phase of the heavy construction work on this building was going on at a very fast clip.

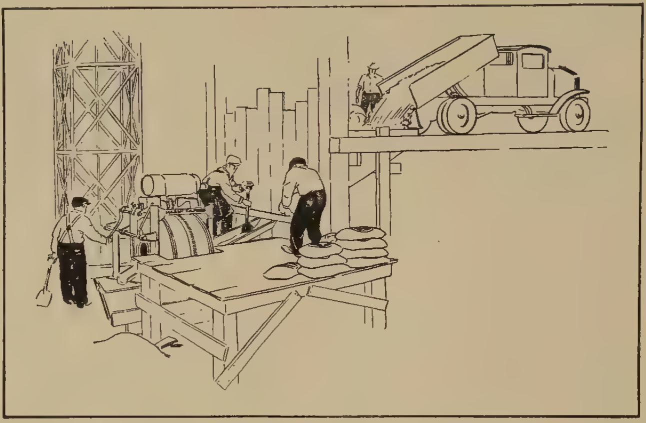
The superintendent on the work, Harry Grimes, attributed a good share of the fine results to an excellent organization and an efficient layout. On the mixer proper, one man handled the gravel; one, the sand; another, concrete, and the fourth was stationed at the discharge spout. There was also one man in charge of the hoist and 15 men on the floors spreading the concrete.

In building the layout, a well supported platform or runway was first constructed. This ran back from an alley at the alley level so that trucks carrying sand, gravel and cement could be backed up and unloaded on the platform.

Large bins were provided below the platform for storing the sand and gravel. A wooden chute alongside the runway was used to carry sacks of cement down to the charging platform where they were stored within easy reach.

While the mixer was discharging, the proper quantities of sand and gravel were released from the main bins into batchers ready to be fed into the machine. When ready for another batch, the sand and gravel were allowed to enter the common chute feeding the mixer. The flow of the sand and gravel was gauged so that the 4½ sacks of cement, added one at a time, were pretty well distributed with the sand and gravel as they went into the drum. A 1:2:4 mix was used, and one minute was given for mixing.

At the discharge end, the operator made certain that the batch was properly mixed before he pulled the lever to discharge. When assured the mixture was ready, the operator discharged it into a wooden chute set at right angles to the discharge spout. One side of the wooden chute was made higher than the other in order that no concrete was lost as the mass was diverted into the hoist bucket lowered at the side of the mixer. The hoist was built near the mixer, and the bottom placed so low that the top rim of the bucket was lower than the wooden discharge chute. Consequently the mix rushed into the bucket at a fast rate yet nothing spilled out.



Usually the hoist operator had a full view of the work, and the instant the skip was filled, it was hoisted quickly to the desired floor. However, a rope and bell were placed at the discharge operator's elbow and used to signal the hoist engineer if he didn't see that the load was ready. At the required floor level the skip was automatically dumped into a hopper, and the concrete was carried from this hopper to the point of application. The round trip of the hoist bucket was made in a very few seconds.

One of the first things noted on this mixer outfit was the advantage taken of the force of gravity. Starting with the dumping of the sand and gravel, bins and chutes were constructed at such a pitch that no time was lost in coaxing the material along or cleaning out the chutes. The sand and gravel fed into the mixer without clogging and the final mix swished into the skip despite a right angle change of direction. The mixer used had a ¾-yard capacity so that 40 batches of concrete were mixed per hour. 160 before the noon whistle and the same number in the afternoon—to make the day's total of 240 yards. The men in charge of this work made no special effort to break any records but merely tried to do a good job.

# *Bookkeeping—* The Key to Profit *in Products Plants*

## The Concluding Article in This Series Showing How Accurate Bookkeeping Increases Profits — This Final Chapter Discusses the Monthly Profit and Loss Statement and the Balance Sheet—Treatment of Discount to Customers—Treatment of Credit Losses—Cost of Sales and Block Inventories—Monthly Inventory Valuations—General Ledger Accounts—Conclusion

By **WILLARD R. GINDER, C. P. A.**
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Consulting Accountant, National Concrete Products Association

## Part V

IN order to take a monthly Statement of Profit and Loss and Balance Sheet from any set of books, it is necessary to see that all invoices, for materials and supplies which have been received and for various expenses which have been incurred, are entered, and that all accrued items of income and expense have been properly set up. This is a general principle of accounting which is applicable to all lines of business, and we do not therefore deem it necessary to discuss it here in further detail.

### Treatment of Discount to Customers

Many block plants find it necessary to offer large cash discounts to customers, and unless these discounts are properly accounted, it will probably be found that the monthly profit and loss will vary in rather unexpected ways. For instance, the sales made during a certain month may be comparatively high and a satisfactory profit would be expected, but if discounts were not properly accounted and heavy collections were made during the month, it might be found that the discounts allowed have very materially cut into the profits otherwise made.

To avoid such variations, it is suggested that the average rate of discount allowed during the past two or three years be determined, as a percentage of gross sales during the same period. An entry may then be made each month, debiting Discounts Allowed and crediting Reserve for Discounts on Sales, of an amount equal to the gross sales for the month multiplied by the average rate of discount allowed as determined above. This practice will result in taking as a loss each month the estimated discount which will be allowed on that month's sales. The actual discounts allowed during any month are debited to the reserve for discounts on sales, and do not therefore affect the profit and loss of the month in which they were allowed.

The balance in the reserve for discounts on sales may be tested at the end of the month, by taking the trial balance of accounts receivable and computing the discounted value of each account subject to discount, and the difference between total accounts receivable and the discounted value of the accounts should equal or be less than the balance in the reserve account.

Another method, which is more conservative but involves greater detail, requires that only the discounted value of each sales invoice be credited to sales, and that the total possible discount on each sales invoice be credited to the reserve for sales discounts. Columns are then provided in the cash receipts record, so that all discount allowed customers upon payment of invoices is debited to the reserve, and so that all discount which is disallowed upon the payment of each sales invoice is debited to the reserve and credited to sales or to an income account termed "Sales Discount Not Allowed." This method is very exact, but it entails considerable work and is not therefore recommended for small plants, unless rates of discount allowed are very variable or the discount policy has recently been changed.

### Treatment of Credit Losses

Many block plants suffer rather heavy losses on account of bad debts, ranging from 0.25 per cent to 2 per cent of gross sales. It is suggested that probable losses of this nature be provided for each month, in a way similar to that suggested above for cash discounts. If this is carefully done, each month will bear its share of losses from bad debts in proportion to the sales made during that month, and the reserve for bad debts account should at all times be sufficient to absorb such losses. This will be true, provided there is no relaxation of vigilance in extension of credits, and of effort in making collections.

### Cost of Sales and Block Inventories

Under our discussion of material, we have shown how the books may be made to reflect cost of material used and sold each month, and laid-down value of materials on hand at the end of each month. If this procedure with regard to material, and that outlined above with regard to general accounting, discounts and bad debts, have been followed, the books will now be in such condition that financial statements may be prepared from them, with

*Figure 13*

## STANDARD CONCRETE PRODUCTS COMPANY

### STATEMENT OF PROFIT AND LOSS

Period Ended ____________________, 192___.

| | CURRENT MONTH | | | | YEAR TO DATE | | | |
|---|---|---|---|---|---|---|---|---|
| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. |
| MANUFACTURED PRODUCTS | | | | | | | | |
| 1. Gross Sales | | | xx | | | | xx | |
| 2. Discount Reserve | xx | | | | xx | | | |
| 3. Returns | xx | | | | xx | | | |
| 4. Allowances | xx | | | | xx | | | |
| 5. Delivery Expense—Schedule 1 | xx | xx | | | xx | xx | | |
| 6. Delivery Income | | xx | xx | | | xx | xx | |
| 7. NET SALES | | | | xx | | | | xx |
| Materials: | | | | | | | | |
| 8. Inventory—1st of Period | xx | | | | xx | | | |
| 9. Purchases, Freight, Etc. | xx | xx | | | xx | xx | | |
| 10. Inventory—End of Month | | xx | | | | xx | | |
| 11. Used—All Purposes | | xx | | | | xx | | |
| 12. Sold | xx | | | | xx | | | |
| 13. Used in Construction, Etc. | xx | xx | | | xx | xx | | |
| 14. Used in Manufacturing Blocks | | xx | | | | xx | | |
| 15. Direct Labor | | xx | | | | xx | | |
| 16. Mfg. Expense—Schedule 2 | | xx | | | | xx | | |
| 17. Cost of Manufacture | | xx | | | | xx | | |
| 18. Blocks Purchased | | xx | | | | xx | | |
| 19. Inventory—1st of Period | | xx | xx | | | xx | xx | |
| 20. Inventory—End of Month | | xx | | | | xx | | |
| 21. Used in Construction, Etc. | | xx | | | | xx | | |
| 22. Sold Inter-Plant at Cost | | xx | xx | | | xx | xx | |
| 23. Cost of Blocks Sold | | | | xx | | | | xx |
| 24. Gross Profit | | | | xx | | | | xx |
| 25. Selling Expense—Schedule 3 | | | xx | | | | xx | |
| 26. Office Expense—Schedule 4 | | | xx | | | | xx | |
| 27. Administration Expense—Schedule 5 | | | xx | xx | | | xx | xx |
| 28. Net Profit | | | | xx | | | | xx |
| MISCELLANEOUS | | | | | | | | |
| 29. Sales—Miscellaneous Materials | xx | | | | xx | | | |
| 30. Delivery Income | xx | xx | | | xx | xx | | |
| 31. Cost of Sales—Line 12 Above | xx | | | | xx | | | |
| 32. Delivery Expense—Schedule 1 | xx | xx | | | xx | xx | | |
| 33. Gross Profit | | | xx | | | | xx | |
| 34. Other Income—Schedule 6 | | | xx | | | | xx | |
| 35. Total Miscellaneous Income | | | xx | | | | xx | |
| 36. Miscellaneous Expense—Schedule 7 | | | xx | | | | xx | |
| 37. Net Miscellaneous Income | | | | xx | | | | xx |
| 38. Net Profit for Period | | | | xx | | | | xx |

one important exception. Cost of blocks sold during the month, and value of blocks in inventory at the end of the month, must be determined before the statement of Profit and Loss and Balance Sheet can be prepared.

Theoretically, the inventory value of blocks on hand at the beginning of the month plus cost of blocks manufactured during the month equals cost of blocks sold during the month plus inventory on hand at the end of the month. Having the first two items, it should therefore be necessary to compute only one of the last two items in order to complete this equation, but unfortunately the above equation is not strictly true.

Blocks become broken during the month, some may be used for construction or other purposes, and some may be stolen. Blocks used for other purposes can and should be accounted for, but it is not always possible to account for all blocks broken, nor for those which are stolen, during the month in which the breakage or theft occurs. The loss from these sources will probably be rather small, however, and its proper monthly allocation need not give us great concern.

Considerable work would be involved in accurately computing both cost of blocks sold and value of blocks in inventory every month, although computation of each offers a valuable check on the other, and both should therefore be computed when semi-annual statements are prepared.

Accurate computation of these items each month would require the maintenance of a perpetual inventory record of blocks at manufacturing cost. Maintenance of such a record would involve considerable labor and would require accurate costing of each run, which would be rather expensive procedure for most block plants.

It is suggested that the semi-annual block inventories have each type and size unit contained in them accurately priced at cost, but monthly profit and loss can be determined with sufficient accuracy to be of practical value with considerably less work.

### Monthly Inventory Valuations

Practically every block plant now maintains records of quantities of each type and size unit manufactured, sold and on hand, and has statements prepared each month showing the number of each type and size manufactured

*Figure* 14

## STANDARD CONCRETE PRODUCTS CO.

### SCHEDULE 1

### DELIVERY EXPENSE

Period Ended ______________________, 192____.

| | Current Month | Year to Date |
|---|---|---|
| Hauling Blocks | | |
| Hauling Material Sold | | |
| Loading Labor—Blocks | | |
| Loading Labor—Material Sold | | |
| General Delivery Expense | | |
| Totals | | |
| *Distribution* | | |
| Blocks—To Line 5, P. & L. Statement | | |
| Materials Sold—To Line 32, P. & L. Statem't | | |
| Totals | | |

*Schedule* 2

### MANUFACTURING EXPENSE

| | Current Month | Year to Date |
|---|---|---|
| Power, Heat and Light | | |
| General Plant Expense | | |
| General Yard Expense | | |
| Repairs—Buildings | | |
| Repairs—Machinery and Equipment | | |
| Repairs—Yard | | |
| Rent | | |
| Water | | |
| Taxes—Real Estate | | |
| Insurance | | |
| Small Tools | | |
| Pallet Cleaning and Oiling | | |
| Supplies | | |
| Telephone | | |
| Testing Blocks | | |
| Salary—Management | | |
| Supervision | | |
| Watchmen | | |
| Sundry Indirect Labor | | |
| Depreciation—Buildings | | |
| Depreciation—Machinery and Equipment | | |
| Depreciation—R. R. Siding | | |
| Depreciation—Yard Equipment | | |
| Depreciation—Motor Trucks | | |
| Proportion of Office Expense | | |
| Totals | | |
| Less: Redistributed Items (Mfg. Exp. Relief) | | |
| Net Totals—To Line 16, P. & L. Statement | | |

and sold during the month, and on hand at the end of the month. Such a record can be kept very fairly accurate by making a physical count of the number of any type or size unit on hand, whenever the inventory record indicates that the stock of such a unit is low. The inventory record may then be corrected to agree with the physical count, and will in this way be kept in constant adjustment.

For preparation of monthly statements, it is first suggested that inventory of blocks on hand at the end of the month be computed rather than cost of blocks sold. This will result in any adjustments, which have been made in the perpetual inventory records during the month, being "washed out" through cost of sales. It is then suggested that plants which do not maintain a regular cost system value the end of month inventory for regular monthly statement purposes by an approximate method somewhat as follows:

Convert last semi-annual inventory into its total dry-weight, and by dividing total value of the inventory by its total dry-weight obtain inventory value per dry-weight pound.

Add total dry-weight sold during the month to total dry-weight sold during months intervening since last semi-annual inventory, to obtain total dry-weight sold to date.

Add total dry-weight produced during the month to total dry-weight produced during the months intervening since last semi-annual inventory, to obtain total dry-weight produced to date.

Add total cost of goods manufactured during the month to total cost of goods manufactured during the months intervening since the last semi-annual inventory, to obtain total cost of goods manufactured to date.

Divide total cost of goods manufactured to date by total dry-weight produced to date, to obtain cost of manufacture per dry-weight pound produced to date.

Value of inventory of finished blocks at the end of the month is then computed by one of the following two methods:

(1) To be used when total dry-weight sold to date is less than dry-weight in last semi-annual inventory:

Value that portion of end of month inventory, which equals difference between dry-weight in last

*Figure* 15

## STANDARD CONCRETE PRODUCTS CO.

### SCHEDULE 3

### SELLING EXPENSE

Period Ended ______________________, 192____.

| | Current Month | Year to Date |
|---|---|---|
| Advertising | | |
| Automobile Depreciation | | |
| Automobile Maintenance and Repairs | | |
| Automobile Insurance | | |
| Commissions | | |
| Entertaining and Traveling | | |
| General Selling Expense | | |
| Salary—Management | | |
| Salaries—Salesmen | | |
| Telephone and Telegraph | | |
| Totals—To Line 25, P. & L. Statement | | |

*Schedule* 4

### OFFICE EXPENSE

| | Current Month | Year to Date |
|---|---|---|
| Auditing | | |
| Furniture and Fixtures Depreciation | | |
| General Office Expense | | |
| Office Building Depreciation | | |
| Office Building Maintenance and Repairs | | |
| Rent | | |
| Salaries | | |
| Stationery and Supplies | | |
| Telephone and Telegraph | | |
| Totals | | |
| Less: Proportion to Mfg. Expense | | |
| Net Totals—To Line 26, P. & L. Statement | | |

*Schedule* 5

### ADMINISTRATIVE EXPENSE

| | Current Month | Year to Date |
|---|---|---|
| Bad Debts | | |
| Collection Expense | | |
| Donations | | |
| Dues and Subscriptions | | |
| Entertaining and Traveling | | |
| Experimental Expense | | |
| General Administrative Expense | | |
| Interest on Notes | | |
| Interest on Mortgage | | |
| Life Insurance | | |
| Salary—Management | | |
| State Taxes | | |
| Totals—To Line 27, P. & L. Statement | | |

semi-annual inventory and dry-weight sold to date, at value per dry-weight pound contained in inventory at beginning of period.

Value balance of end of month inventory at cost per dry-weight pound produced to date.

(2) To be used when total dry-weight sold to date is greater than dry-weight in last semi-annual inventory:

Value entire end of month inventory at manufacturing cost per dry-weight pound produced to date.

This method, which might be considered somewhat rough, will be found sufficiently accurate for use in preparing monthly statements. No wide variations will probably be noted, unless there is great variation in the proportion of face blocks and other high cost special units from one inventory to another. The basic principle upon which this method is based, involves the assumption that the most recently manufactured goods are still on hand.

In accurately valuing semi-annual inventories by pricing each type and size unit at manufacturing cost, care must first be taken to value all units carried over from the last semi-annual inventory at the value they carried at that time if it is lower than the current manufacturing cost. It is also suggested that current manufacturing cost for valuation of the rest of the inventory be computed at average overhead rates for the past six or twelve months, and that no attempt be made to compute exact overhead rates for each month and apply such rates to the cost of units manufactured during that month.

*Figure* 16

## STANDARD CONCRETE PRODUCTS CO.

### SCHEDULE 6

### OTHER MISCELLANEOUS INCOME

Period Ended ______________________, 192____.

| | Current Month | Year to Date |
|---|---|---|
| Sales of Capital Assets | | |
| Less: Cost of Sales | | |
| Profit or Loss on Sales of Capital Assets | | |
| Scrap Sales | | |
| Rent Received | | |
| Interest Received | | |
| Purchase Discount Taken | | |
| Bad Debts Recovered | | |
| Other Income | | |
| Totals—To Line 34, P. & L. Statement | | |

### *Schedule* 7

### OTHER MISCELLANEOUS EXPENSES

| | | |
|---|---|---|
| | | |
| Totals—To Line 36, P. & L. Statement | | |

### *Schedule* 8

### FINISHED BLOCK INVENTORY—END OF PERIOD

| | | |
|---|---|---|
| 1. Manufacturing Cost to Date—From Line 34, P. & L. Statement | | |
| 2. Dry-weight Produced to Date | | |
| 3. Manufacturing Cost per Dry-weight Lb. | | |
| 4. Total Dry-weight on Hand—1st of Year | | |
| 5. Total Dry-weight Sold to Date | | |
| 6. Amount on Line 4 Minus Amount on Line 5 | | |
| 7. Total Dry-weight on Hand—End of Month | | |
| 8. Amount on Line 6 (If Any) | | |
| 9. Amount on Line 7 Minus Amount on Line 8 | | |
| 10. Inventory Value per Dry-weight Pound—1st of Year | | |
| 11. Amount on Line 6 Times Price on Line 10 | | |
| 12. Amount on Line 9 Times Price on Line 3 | | |
| 13. Amount on Line 11 Plus Amount on Line 12 | | |

### Financial Statement Forms

Having computed the value of the end of the month inventory and properly accounted any blocks used for construction, etc., and all known breakage, the monthly Statement of Profit and Loss and end of month Balance Sheet may now be prepared. The forms shown in Figures 13 to 19 are suggested for this purpose.

It may be desired to condense these forms somewhat before typing for distribution. This may be done to any extent desired, but we suggest that the original statements taken off by the bookkeeper contain the full details shown on the suggested forms, and that condensing be done after they are prepared.

The material accounts have been condensed on the Statement of Profit and Loss as follows:

(a) Total of all balances in Inventory Accounts, i. e., inventories at beginning of year, is inserted on line 8 in column 5.

(b) Total of all balances in Purchases, Freight, Cartage, Handling, Testing and Storage, etc., Accounts is inserted on line 9 in column 5.

(c) Total of all balances in Relief Accounts is inserted on line 11 in column 6.

(d) The amount on line 13 in column 5 is not the balance of an account. It is the value of materials disposed of, other than those consumed in manufacturing, or sold, and must be obtained from the monthly journal entries charging such materials to the proper accounts.

(e) The amount on line 8 in column 1 is that which appeared on line 10 in column 2 of the statement for the previous month.

Inventory of finished blocks at the beginning of the year is inserted on line 19 in column 6. This is the balance in the Finished Block Inventory Account, which it is suggested be carried in the books without change during the year. The amount on line 19 in column 2 is that which appeared on line 20 in column 2 of the statement for the previous month.

### General Ledger Accounts

Practically all general ledger accounts, which are necessary to the accomplishment of the results outlined up to this point, are shown on the Statement of Profit and Loss and Balance Sheet illustrated, or have been discussed herein. It is suggested that the General Ledger be arranged with the accounts in the order in which they appear on the Balance Sheet and Statement of Profit and Loss, respectively, with such guide tabs as may be considered necessary. A simple set of guide tabs would consist of Assets, Liabilities, Capital, Sales, Manufacturing, Operating Expense and Miscellaneous.

### Conclusion

As stated in the first article of this series, the methods we have outlined are not suggested for adoption as standard.

We also strongly advise that no attempt be made to install such procedure in a plant without the assistance

*Figure* 17

Sheet 1

## STANDARD CONCRETE PRODUCTS COMPANY

### BALANCE SHEET

Month Ended ______________, 192___.

| ASSETS | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Cash in Bank | | | | |
| 2. Petty Cash | | | | |
| 3. Accounts Receivable—Trade | | | | |
| 4. Notes Receivable—Trade | | | | |
| 5. Notes Receivable—Discounted | | | | |
| 6. Reserves for Credit Losses | | | | |
| 7. Reserve for Discounts—Sales | | | | |
| 8. | | | | |
| 9. Raw Material Inventory | | | | |
| 10. Bldg. Material Inventory | | | | |
| 11. Finished Block Inventory | | | | |
| 12. Cement Sacks | | | | |
| 13. | | | | |
| 14. TOTAL CURRENT ASSETS | | | | |
| | Asset Balance | Depreciat'n Reserve | Net Book Value | |
| 15. Land | | | | |
| 16. Leasehold Improvements | | | | |
| 17. Buildings | | | | |
| 18. Machinery and Equipment | | | | |
| 19. Furniture and Fixtures | | | | |
| 20. Railroad Siding | | | | |
| 21. Automobiles | | | | |
| 22. Motor Trucks | | | | |
| 23. Tractors | | | | |
| 24. | | | | |
| 25. TOTAL FIXED ASSETS | | | | |
| 26. Machinery Parts | | | | |
| 27. Coal | | | | |
| 28. Factory Supplies | | | | |
| 29. Accrued Interest Receivable | | | | |
| 30. Accrued Rent Receivable | | | | |
| 31. Deposits | | | | |
| 32. Prepaid Insurance | | | | |
| 33. Prepaid Life Insurance | | | | |
| 34. Prepaid Interest | | | | |
| 35. Prepaid Rent | | | | |
| 36. Prepaid Taxes | | | | |
| 37. Prepaid Advertising | | | | |
| 38. Real Estate Investment | | | | |
| 39. Less: Reserve for Depreciation | | | | |
| 40. Stocks and Bonds | | | | |
| 41. Mortgages | | | | |
| 42. C. S. Value of Life Insurance | | | | |
| 43. Notes Rec.—Other Than Trade | | | | |
| 44. Accts. Rec.—Other Than Trade | | | | |
| 45. Advances to Salesmen, Etc. | | | | |
| 46. Total Forwarded to Sheet 2 | | | | |

*Figure* 18

Sheet 2

## STANDARD CONCRETE PRODUCTS COMPANY

### BALANCE SHEET

Month Ended ______________, 192___.

| ASSETS (Continued) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 46. Total Forwarded from Sheet 1 | | | | |
| | Asset Balance | Amortizat'n Reserve | Net Book Value | |
| 47. Leaseholds | | | | |
| 48. Organization Expense | | | | |
| 49. Good Will | | | | |
| 50. | | | | |
| 51. TOTAL AMORTIZABLES | | | | |
| 52. | | | | |
| 53. | | | | |
| 54. | | | | |
| 55. TOTAL ASSETS | | | | |
| LIABILITIES | | | | |
| 56. Notes Payable—Banks | | | | |
| 57. Notes Payable—Other | | | | |
| 58. Accounts Payable—Trade | | | | |
| 59. Accounts Payable—Other | | | | |
| 60. Salaries Payable | | | | |
| 61. Unclaimed Wages | | | | |
| 62. Loans Payable | | | | |
| 63. | | | | |
| 64. | | | | |
| 65. | | | | |
| 66. Cash Sales Suspense | | | | |
| 67. TOTAL CURRENT LIABILITIES | | | | |
| 68. Accrued Wages | | | | |
| 69. Accrued Salaries | | | | |
| 70. Accrued Taxes | | | | |
| 71. Accrued Rent | | | | |
| 72. Accrued Mortgage Interest | | | | |
| 73. Accrued Interest on Notes | | | | |
| 74. Accrued Insurance | | | | |
| 75. Accrued Hauling | | | | |
| 76. Accrued Commissions | | | | |
| 77. Mortgages Payable | | | | |
| 78. | | | | |
| 79. | | | | |
| 80. | | | | |
| 81. Preferred Stock Issued | | | | |
| 82. Common Stock Issued | | | | |
| 83. Surplus | | | | |
| 84. Prior Period Profit and Loss | | | | |
| 85. Current Profit and Loss | | | | |
| 86. TOTAL LIABILITIES | | | | |

*Figure* 19

STANDARD CONCRETE PRODUCTS COMPANY

SCHEDULE 9

RECONCILEMENT AND ANALYSIS OF SURPLUS

Period Ended ____________, 192___.

| | CURRENT MONTH | | YEAR TO DATE | |
|---|---|---|---|---|
| | Dr. | Cr. | Dr. | Cr. |
| Balance—1st of Month—Year | * | * | ** | ** |
| Changes in Surplus: | | | | |
| Changes in Prior Period P. & L.: | | | | |
| Amounts on Line 38, P. & L. Statement | | | | |
| Totals | | | | |
| Balance—End of Period | | | | |

*Balance—End of Period, per Schedule 9 of Preceding Month.

**Balance at Beginning of Year.

of a competent accountant, who is familiar with the industry. In any case, such an installation should be preceded by a thorough survey and analysis of operating methods and routine.

*(The End)*

## Building Codes Recognize Concrete Masonry Units

The Underwriters' Laboratories inspection service for concrete masonry units is beginning to be reflected in city building codes, and in all probability further progress will be made in this direction. Quotations from building codes, in which the Underwriters'-inspected concrete units are given special consideration, will be found in the paragraphs that follow:

New Orleans Building Code. Up to February 29, 1928, when certain amendments to the New Orleans Building Code were adopted, that code specifically prohibited the use of hollow masonry units of concrete or clay in party walls and fire walls. One of the amendments referred to permits such use for the Underwriters'-inspected block. The amendment reads: "Party and fire walls may be constructed of hollow concrete or (clay) tile blocks, provided such blocks have met the test requirements of the American Society for Testing Materials and of the National Board of Fire Underwriters, and are manufactured under the supervision of the Underwriters' Laboratories, Inc., and so certified."

Uniform Building Code for Pacific Coast Cities. The 1927 Edition of the Uniform Building Code for Pacific Coast cities, prepared by the Pacific Coast Building Officials' Conference, divides concrete masonry units into Grade A and Grade B. Units of Grade A are placed on the same basis as solid masonry units with respect to wall thicknesses, and virtually on the same basis with respect to use. However, all units manufactured under the inspection service of the Underwriters' Laboratories and meeting the Underwriters' specifications are classified as Grade A. The specific provisions that put these requirements into effect are found in Sections 2406 and 2909.

Sarasota Building Code. The Building Code of Sarasota, Florida, adopted in November, 1926, contains the following as the first paragraph of Section 38: "All concrete brick, concrete block, sand-lime brick or soft brick, and all wall-bearing tile used in the City of Sarasota shall be manufactured under the supervision of, and bear the label of, the National Board of Fire Underwriters, which is furnished by the Underwriters' Laboratories, 207 East Ohio Street, Chicago, Illinois, or the equivalent thereto."

A significant feature of the situation is that manufacturers of hollow clay tile are not as yet in a position to obtain this inspection service, for the reason that their material has not succeeded in passing the standard fire and water tests of the Underwriters' Laboratories. Concrete masonry units, on the other hand, have passed four major series of fire and water tests conducted in 1922, 1924, 1926 and 1927. Complete reports of those tests will be found in the Underwriters' Retardant Reports No. 1429, 1555, 1881 and 2051. Consequently in cities where provisions similar to the New Orleans amendments are adopted concrete masonry is given a well-merited advantage over hollow clay tile units.

The wording of these provisions in the New Orleans and Sarasota codes indicates some confusion as to the organization that is responsible for the inspection service. The exact phraseology can be obtained by addressing the Underwriters' Laboratories, 207 East Ohio St., Chicago.

## Chicago to Lay Its First All-Concrete Street in "Loop"

Chicago's first complete concrete street in its principal business section is to be laid some time this spring. It will be laid on LaSalle street, for a length of two blocks. The pavement is to be 67 ft. in width for one block and 86 ft. wide in the second block. The cost will be $231,564.

For several years Chicago has awarded a large share of its residence street paving for concrete, sometimes selecting this type for upward of 50 per cent of its program. The city has also a stretch of concrete on Michigan Boulevard, in the Lincoln Park district, which bears the heaviest traffic in the city.

The use of unit materials has largely dominated downtown paving due to the fact that as in other large cities there has been constant digging up of streets for the installation of public utilities.

In the case of LaSalle street, however, all underground work is to be put into such shape that repairs, connections and other work on utilities will not necessarily have to bring about destruction of the surface. Tunneling, it is expected, will be the method by which this work will be handled in the future.

# Practical Application of the Water-Cement Ratio Method of Controlling Concrete

## Strength Specifications Demonstrated as Practical—How to Write a Specification Incorporating the Water-Cement Ratio Control Method—Revising Building Code Requirements—Economy of Controlled Concrete

By W. E. HART

MOST city building inspection officials have some knowledge of the influence of the water-cement ratio on the strength of concrete. This principle is well understood by some, but only vaguely by others.

The test of the value of the water-cement ratio control of the strength of concrete came with its practical application. The method is now a part of every-day construction practice. Curiously enough, some of those who have not gone at least some distance into the matter are under the mistaken impression that the water-cement ratio method of control is too complicated in theory and too complex in its practical application to be of value. The method is very simple in its application, and what was once an experiment has long since passed that stage and has proved a splendid success.

### Demonstrated on the Job

For the past five years the water-cement ratio method of designing concrete mixes has been used on many kinds of construction projects. Many laboratories throughout the country have checked and rechecked the principles involved in the water-cement ratio theory, until today this method of proportioning mixes is no longer a theory but a fact.

At the beginning, the majority of projects that employed the water-cement ratio specification did not come under the jurisdiction of city and building officials. These examples, however, demonstrated the value of the new specification and encouraged contractors and engineers to ask for special permits to use this form of construction within cities. In a few cases, special provisions were made by building departments to permit the use of this specification under their building code. As a result, hundreds of projects have been completed in an extremely satisfactory manner from the standpoint of safety, ease of operation and economy. One prominent Canadian engineer has placed over three-quarters of a million yards of concrete by controlling the relationship of cement to water and making the relationship of cement to aggregate secondary.

It is safe to assume that from this time on, building officials will be confronted with this form of specification and must rule for or against its use. Later on in the paper, a method is offered whereby the use of this form of specification may be permitted under existing building codes without serious change to the code.

An excellent example came to my attention last week that should help clear up the ease and practicability of its application on the normal building job. An average contractor had a sixteen-story apartment building in one of our large cities, in which the plans called for concrete to be placed under the old method of arbitrary mixes. He requested the privilege of meeting the building code requirements as to strength by the use of the water-cement ratio method and daily tests of the concrete. Such permission was granted. At the completion of his job, the concrete averaged 600 pounds over the required strength, with the lowest cylinder testing 300 pounds over that required by the design. Besides this, the saving to the contractor was more than enough to pay for the expense of all tests and the engineering service. Out of 3000 yards of concrete placed there were not more than six square feet of honeycombed spots to be patched.

Once the problem of placing concrete under this specification is understood by the contractor, he will immediately see that his job will run smoother because of the elimination of the usual controversy and friction between the engineer and contractor. With the removal of this battleground, it requires no stretch of imagination to recognize how much easier it will be for the building inspector.

### Check Tests

Another fact should be stressed. Under the old method of arbitrary mixes, a 1:2:4 combination was assumed to produce 2000-pound concrete. Tests were often made, but very seldom required. These tests revealed a wide variation in strength and little or no uniformity in the concrete. Under the water-cement ratio form of specification, tests and daily control are usually required, so that you as an official know definitely the strength of the concrete. From this standpoint this one detail alone should have a strong appeal.

Tests illustrate another important principle, namely, that control of the quantity of mixing water does not necessarily mean dry concrete. It does mean concrete of uniform strength. The consistency may be varied to any degree of workability desired. By maintaining a constant water-cement ratio, the quality of concrete is maintained constant and the difficulties of placing are overcome by adjusting the quantity of aggregate so as to give greater fluidity. This is exactly in accord with the practice with other structural materials. For instance, in the framing of a complicated system of structural steel members it is not the custom to reduce the requirements of the specification and permit inferior results simply because the fabrication and erection involve additional expense. On

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A paper presented at the annual meeting of the Building Officials Conference of America, Detroit, April 24-27, 1928.

the contrary, the quality is maintained and the difficult members are fabricated and assembled at greater expense. This is just what is accomplished by the control of water in mixing concrete. The quality is fixed by the amount of water for each sack of cement, and the workability is adjusted to meet the conditions encountered in each particular part of the structure.

## A Water-Cement Ratio Specification

We often receive requests for information as to how specifications for structures may be written so as to incorporate the water-cement ratio method of control. Many of these requests clearly indicate a lack of understanding of the simplicity of this method. The letters betray the impression that the method is a very complicated matter which the writer dreads to undertake.

Likewise, we often encounter city building officials who do not permit the incorporation of the water-cement ratio method in building regulations, because of the fear that it would involve too many changes in the code and might create certain contradictory provisions.

In both instances the fear is entirely unfounded. The incorporation of the water-cement ratio method of control, in specifications for buildings, bridges and other structures, actually simplifies such specifications.

Building officials are referred to the building codes of Des Moines, Iowa, Kansas City, Kan., Shreveport, La., Fort Worth, Tex., Dayton, Ohio, and others in which the water-cement ratio method has been incorporated since your last annual meeting. In addition to the five city codes just named, the Department of Commerce Building Code Committee's "Recommended Building Code Requirements for Working Stresses in Building Materials," the proposed "Standard Building Regulations for Reinforced Concrete" issued by the American Concrete Institute, the proposed uniform building code for Pacific Coast cities, and the codes of Indianapolis, Sacramento, Dallas, Beaumont, Meridian and at least ten smaller cities have incorporated the water-cement ratio method. This makes a total of 19 city codes, two national standards, and at least one proposed uniform code that have accepted the water-cement ratio principle. The codes of Pittsburgh, Washington, New Orleans, Detroit and other cities permit full utilization of the strength of concrete as determined by test.

It is not necessary to change all sections of a building code in which reference is made to mixtures or to arbitrary proportions between cement and aggregates. It will be sufficient for the purpose to leave the older requirements undisturbed through the simple procedure of permitting a choice of either the new method or the older arbitrary mixture method.

After all, what is needed is a clear understanding or interpretation of your present code. Let me ask you this question: Is the stability of a building dependent upon a 1:2:4 mix or a 2000-pound concrete? In other words, are you interested in a 1:2:4 mix or a 2000-pound concrete? The answer must necessarily be, a 2000-pound concrete. Therefore, by a proper interpretation of your present code, a strength of 2000, 2500 or 3000 pounds in the concrete is the item that is of most vital importance to you, and not the method by which such strengths are obtained.

Let us now consider the building code phraseology that will give recognition to this method of controlling the quality of concrete. Probably the clearest and most concise wording is contained in a slight modification of the wording in the Department of Commerce Building Code Committee's "Recommended Building Code Requirements for Working Stresses in Building Materials," issued in December, 1926. That phraseology was followed quite closely in the new code of Kansas City, Kan., adopted in December, 1927. The amending section necessary to accomplish this should read about as follows:

> *Ultimate Strength of Concrete.* Regardless of specific proportions specified elsewhere in this code, concrete used in reinforced concrete construction, when mixed in the following approximate proportions, stated by volume, and with the water-cement ratio indicated, may be assumed to develop a laboratory cylinder compressive strength at the age of 28 days, as follows:
>
> | Approximate mixture: Volume of portland cement to sum of separate volumes of fine and coarse aggregates | Water-cement ratio in U. S. gallons of water per 94-pound sack of cement | Assumed ultimate strength, in lbs. per sq. in., at age of 28 days |
> |---|---|---|
> | *Plastic Mass Concrete, Slump 1 to 3 Inches* | | |
> | 1:6 | 7¼ | 2000 |
> | 1:5 | 6½ | 2500 |
> | 1:4 | 5¾ | 3000 |
> | *Moderately Wet Concrete, Slump 6 to 8 Inches* | | |
> | 1:6 | 8 | 1600 |
> | 1:5 | 7¼ | 2000 |
> | 1:4½ | 6½ | 2500 |
> | 1:3½ | 5¾ | 3000 |
>
> Water or moisture contained in the aggregate must be included in computing the water-cement ratio.
>
> Very wet concrete must be avoided in locations that will be exposed to water or to atmospheric conditions. It will be porous and will have low resistance to weathering.
>
> In no case shall concrete for any assumed strength be placed with a water-cement ratio higher than that shown in the above table. Where aggregates are such that the mixtures shown do not produce proper workability with the given water-cement ratios, the mixtures shall be changed, but not the water-cement ratios.
>
> The graded sizes of the combined aggregates shall be such that when separated on a No. 4 standard sieve the weight retained shall be not less than one-half nor more than two-thirds of the total.
>
> If and when it is shown by evidence of tests made by competent authorities satisfactory to the building inspector that concrete of a higher strength than that specified in the above tables will be used, and that competent field control of mixing and placing is assured, or that concrete of less strength will be employed, the working stresses shall be proportionately modified.
>
> The methods of measuring materials shall be such that the proportion of water to cement can be closely controlled during the progress of the work and easily checked at any time by the building inspector.

## Economy

You who are familiar with building construction work are in a position to appreciate the economy that may be obtained through the use of higher strength materials. Consider a structure such as an office building, built primarily for the purpose of bringing a return on an investment. If the sum of $100,000 may be saved in the structural frame of the building through the employment of modern materials of construction and modern methods of their use, the amount so saved may turn out to be the difference between a paying investment and one that is yielding unsatisfactory returns.

Modern building regulations stimulate construction in buildings of the investment type, not office buildings alone, but hotels, apartments, storage warehouses, commercial garages and other kinds of occupancy. On the other hand, no economic advantage can be gained through the use of better materials and better methods of construction if the building laws deal with such matters in an arbitrary manner, permitting working stresses only up to a certain over-conservative figure regardless of the ultimate strength of the material employed. This is well illustrated from an analysis of existing building codes. In many of these codes the working stresses specified are based on the purely arbitrary assumption that the strength of structural concrete will be 2000 lbs. a sq. in. In such cases 1500-pound concrete will be considered sufficiently strong, while 4000-pound concrete will not be allowed any higher working stresses than that of the weaker material. Under such conditions there is little inducement on the part of the designer or the owner to employ a concrete of greater strength.

Many building codes, in fact the majority of them, permit working stresses to be increased proportionately as the crushing strength of the material increases about 2000 lbs. a sq. in., but only up to a certain point. Some city codes place the upper limit at 2500 pounds, others at 2900 pounds, and still others at 3000 pounds. It is true that these codes provide some leeway and some inducement to utilize the economic advantage of concrete of greater strength, but at best they merely raise the arbitrary limit above which the designer is given no inducement to go.

In your dealings with construction projects in which the water-cement ratio is employed as the basis for obtaining high strengths of concrete, you are, of course, justified in requiring that you be furnished with definite knowledge that the strengths specified are being attained. As you know, the strength of concrete at the age of 28 days may be closely estimated from the strength at seven days, because of the thousands of comparisons available in published reports of tests. Consequently you will be able to keep closely behind the progress of the work in your information regarding the quality of the concrete in the structures under your jurisdiction. You should require frequent tests to be made by responsible laboratories, and copies of each report should be furnished directly from the laboratory.

## Sawdust and Cork Tested as Concrete Materials by British Research Board

The Building Research Board of the Department of Scientific and Industrial Research of the British Board of Trade has just issued its first technical report, containing valuable comments on alternative building materials. A year or two ago considerable space was devoted by the London press to articles extolling the virtues of a material composed of a mixture of sawdust and cement. Obviously such a product, being light in weight, if it had satisfactory heat insulating properties, would provide an outlet for enormous quantities of wood dust and chippings which are at present largely wasted. It was proposed to use pressed blocks of this wood-cement composition for the construction of small houses. Blocks of standard size were prepared, made of cement and sawdust, mixed by a chemical process.

The report contains an illuminating comment on this material. Many of the claims made by the manufacturers of the product were substantiated by the preliminary investigations, but one serious disadvantage was discovered. Owing to the shrinkage which wood undergoes when dried and the corresponding expansion when wetted, there is a tendency for the wood particles to break away from the cement; also the large shrinkage of the mass as a whole, due to its high wood content, causes serious difficulty in using the material where it is exposed to atmospheric conditions. The object of the chemical treatment to which the wood was subjected during manufacture was to overcome excessive shrinkage and expansion, but the treatment proved unsuccessful.

Extensive experiments were carried out at the Building Research Station, in conjunction with the technical adviser of the manufacturers, to improve the materials in this respect. Some improvement was effected, but a point was reached beyond which it was not possible to go in reducing the shrinkage of the wood. A subsequent series of experiments dealing with a great variety of chemical treatments has suggested that the shrinkage on drying and the swelling on moistening the wood cannot be prevented by any known means without destroying the valuable mechanical properties associated with timber; also that the initial drying shrinkage of such materials is of a much greater order than movements due to subsequent wetting and drying. The conclusion reached in this particular investigation was that the wood-cement mixture, prepared by pressing into large slabs, could not be recommended for outside use without a waterproof covering. Subsequently the examination of two blocks of four houses built with this material confirmed the opinion formed as a result of the board's experimental work.

Another novel alternative method employed in house construction was the employment of concrete and pressed cork. This particular case was a dwelling built at Betteshanger, Kent, in connection with the influx of miners for whom houses had to be provided. The house was constructed on a steel frame. There was an outer layer of reinforced concrete applied by a cement gun, then a layer of slab cork, then a layer of breeze concrete, and finally a layer of internal plaster. The concrete provided resisttance to weather and the cork and breeze concrete heat insulation.

In this particular case, after a comprehensive series of tests had been made and after modifications had been adopted, it was found that the composite walling provided an alternative construction for small houses which was considered at least as durable, fire-resistant and weatherproof as a standard brick wall. In heat insulation it was superior to the standard brick and it was satisfactory as regards freedom from condensation on internal surfaces.

Tests are still being made on artificial stone, concrete blocks and other materials by the board. In order that investigations should be carried out under natural conditions an experimental house has been built in the grounds of the Building Research Station at Carston, near Watford. The building consists of four rooms, each 14 ft. by 13 ft., the pair on the ground floor being 8 ft. 6 in. in height. The staircase is enclosed in a separate annex, and the wall on this side of the main building is well insulated with a cavity and insulator of hollow, diatomaceous building blocks. The three remaining sides of the main building constitute the experimental walls. The construction of the house consists of a steel frame dividing the three walls into eight panels. These panels are at present filled in with 9-inch brick walling in lime mortar. The walling can be complely removed when necessary and replaced by any other form of walling (for example, 11-inch hollow walling) or by any other type of material without removal of the floors or roof. The windows are of the normal casement type. The first floor is of ordinary timber construction, and the ground floor is of concrete covered with oxychloride flooring.

# Quality Concrete Discussed by Building Officials' Conference of America

The Building Officials' Conference of America held its fourteenth annual meeting in the Statler Hotel, in Detroit, from April 24th to 27th inclusive. All sessions were well attended and interest in the program was well sustained.

The morning session of April 26th was given over entirely to concrete and concrete products. The papers presented in this part of the program included one by W. E. Hart, manager of the Structural and Technical Bureau of the Portland Cement Association, on the subject, "Practical Application of the Water-Cement Ratio Method of Controlling Concrete." He was followed by John M. Bischoff, Commissioner of Buildings and Safety Engineering for Detroit, who read an illustrated paper in which he discussed the co-operation between his department and the contractors of Detroit. Through this co-operation and through careful attention to the water-cement ratio they have succeeded in obtaining concrete of much higher strength than was the case a few years ago.

Mr. Bischoff's paper brought out the surprising fact that since inauguration of the building department's tests and the co-operation between the department and the contractors the average strength of structural concrete has been approximately doubled.

The department makes on an average of about 40 concrete cylinder tests a day during the busiest part of the construction year. As many as 80 tests have been made in a day. A few of the samples of concrete tested during 1927 indicated strengths in excess of 7,000 lbs. a sq. in., while quite a number of samples tested more than 5,000 lbs. a sq. in. The average for all tests made in 1927 was about 3,500 lbs. a sq. in. The average for all tests in 1926 was about 2,900 lbs. a sq. in. The system was inaugurated in 1924.

What is of even greater importance than the high strengths attained, or the high averages, is the virtual elimination of structural concrete testing from 1,000 to 1,500 lbs. a sq. in. When this system of testing was inaugurated in 1924 many of the tests ran between those figures, while some were as low as 600 lbs. a sq. in.

## Tabulate Tests

Another feature that furnishes valuable information to architects and engineers as well as to contractors consists of a mimeographed tabulation issued at the end of each year, showing the results of tests on cylinders representing the work of each contractor. The tabulation shows the number of tests for each contractor, and the low, high and average values obtained during the year. The contractors are listed by number only, the key to the numbers being known only to Mr. Bischoff and the chief chemist of the department. Any individual contractor will, of course, be informed of his own number and he may authorize anyone to verify his claim to a certain number. A contractor who shows consistently good results is in a position to use this tabulation as a selling point with architects and engineers, when bids on new work are received. Not infrequently a contractor, though not the low bidder, will be awarded the contract because of his excellent past performance indicated on the tabulation.

Mr. Hart's paper contained the news that no less than nineteen city building codes and three standard codes of national scope now have incorporated the water-cement ratio specification as an integral part of the code. The three national standards are the proposed uniform building code for Pacific Coast cities, the Department of Commerce Building Code Committee's "Recommended Building Code Requirements for Working Stresses in Building Materials," and the American Concrete Institute's "Proposed Standard Building Regulations for Reinforced Concrete." The city building codes mentioned are those of Dallas, Dayton, Des Moines, Beaumont, Fort Worth, Indianapolis, Kansas City, Kans., Meridian, Shreveport, Sacramento, and at least nine smaller cities on the Pacific Coast which now have adopted the proposed uniform building code prepared by the Pacific Coast Building Officials' Conference. In addition, Mr. Hart said, the codes of Detroit, New Orleans, Pittsburgh and Washington, D. C., permit full utilization of the strength of concrete as determined from tests.

## Ready-Mixed Concrete

During the discussion of Mr. Hart's paper several building officials digressed from the subject in hand to tell of satisfactory results being obtained through the delivery of ready-mixed structural concrete by commercial concerns. Only in one city were the results reported to be unsatisfactory, a condition that was soon explained from the fact that water was being added and the concrete re-mixed at the construction job. This of course increased the water-cement ratio quite materially and produced a correspondingly large reduction in strength.

## Concrete Block Inspection Service

The third paper on the subject of concrete was by H. M. Robinson, service engineer for the Underwriters' Laboratories, who discussed that organization's inspection service and certification of concrete block. This paper likewise caused considerable discussion. A number of questions were asked concerning the actual assurance of a quality product which this service implies. This was explained by Mr. Robinson, who emphasized the important point that their service involves the actual inspection and certification of the block delivered to the construction site. Mr. Robinson explained the difficulties encountered in a previous attempt to adapt the label service to a product such as concrete block and showed how the inspection service and certification is even more effective in accomplishing its purpose.

The inspection trip on the last day of the conference included a visit to the testing laboratory of the Detroit Department of Buildings, where tests of concrete cylinders and other materials were under way. Cylinder tests on 28-day concrete then being made indicated strengths of around 3,800 lbs. a sq. in. Tests of Haydite concrete made a few days before this visit had shown strengths of around 2,700 lbs. a sq. in. Haydite concrete was used on the new Telephone Building about completed and will be used on another structure about to be started.

Officers elected for the current year included Robert Knight, deputy building commissioner of Chicago, as president; John Fowler, building commissioner of Jacksonville, Fla., as vice-president; and Col. John W. Oehmann, inspector of buildings for the District of Columbia, as secretary.

## Coming Convention

June 25th to 29th—American Society for Testing Materials, at Chalfonte-Haddon Hall, Atlantic City, New Jersey. Thirty-first annual meeting.

# Crane Places Precast House Slabs

## Mounted on Narrow Gauge Tracks, Crane Runs Above Site—Houses Consist of Fourteen Slabs—Surface Treatment—Method of Erection

THE economical method of casting level with the ground monolithic slabs for house construction and lifting them into position by means of a crane has been developed to a workable stage by Great Britain builders, according to a recent issue of *Concrete for the Builder and Concrete Products,* from which the following material is taken.

### Plant

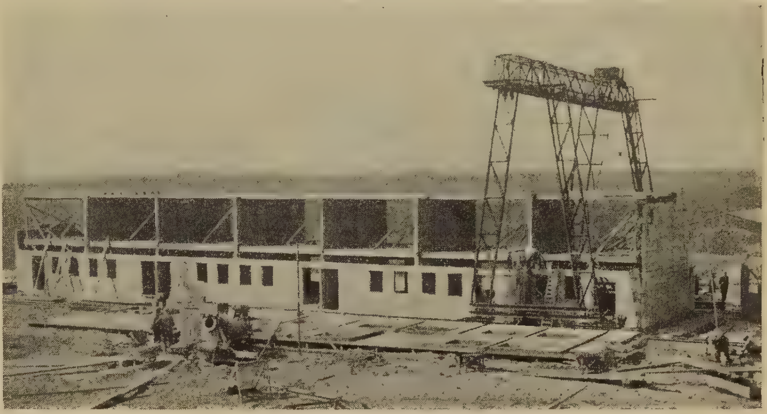
Thirty houses have just been completed at Cambridge, England, by the British Occident Concrete Construction Co., Ltd., by this method.

In the Occident system, the walling is precast in large sections and placed in position by a transporter crane. The cost of this plant and its erection is a fairly costly item, and is only justified on projects comprising a large number of houses on one site. Beyond the crane, the expenditure on plant is very small. A narrow-gauge track is laid each side of the site, and on this the transporter is erected so that it travels over the site of the houses to be erected and can pick up precast slabs from outside the track and place them in any position inside the tracks.

### Casting Slabs

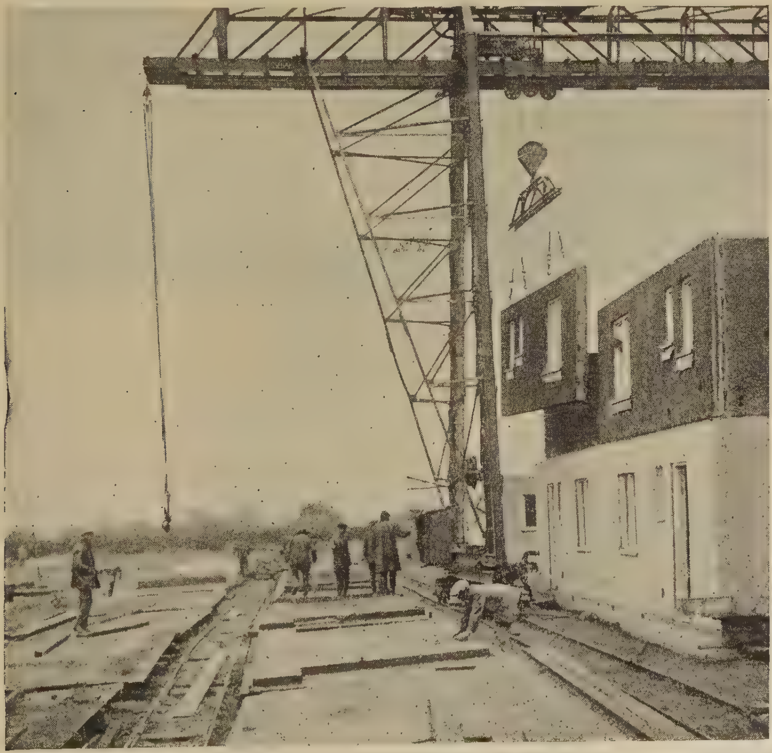
At Cambridge, each pair of houses consists of fourteen slabs; the front and back of each house is made up of two slabs, one for the ground floor and one for the upper story (eight slabs in all for the front and back walls of the pair); the end walls of the pair are formed of two slabs, one for the ground floor and one for the upper floor; while the party wall to each floor is precast as one slab.

These slabs are moulded on wood platforms beside the site of the house of which they are to form part. Window and door frames are placed in position before concreting commences so that the labor necessary after the walls are erected is reduced to a minimum and at the same time the woodwork is securely fixed in the wall.



*Lower story completed, showing layout of plant*

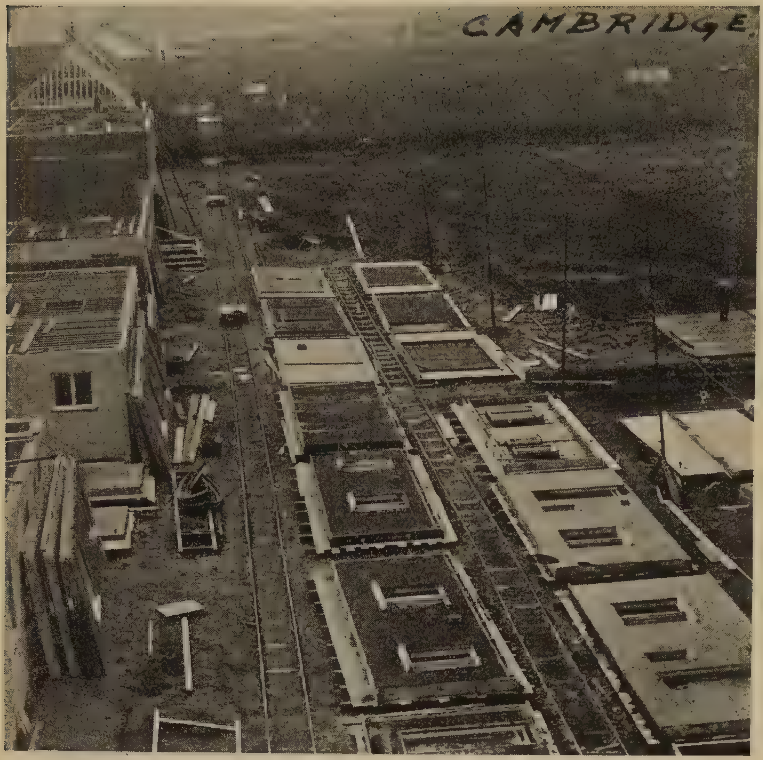
The fact that these slabs are cast horizontally gives almost unlimited scope for using different concretes without the expensive formwork necessary when different mixes are poured vertically. In this system breeze concrete is used for the inner face and ballast concrete for the outer face. The slabs are made with the inner face down. Two inches of 1:7 breeze concrete are first spread over the platform; next is placed 3½ inches of breeze without cement or other binding agent; and finally a 2-inch layer of 1:4½ ballast concrete to provide a weatherproof external face. It is claimed that a wall of this type has three times the insulating properties of a brick wall of the same thickness, and that it has high sound-resisting properties. The breeze concrete inner face prevents condensation, and forms an excellent key for plaster; it is found that a browning coat only is necessary to give satisfactory results. The core of loose breeze or other filling fulfills the same function as a cavity, but is claimed to be more efficient than a hollow space in maintaining an equable indoor temperature.



*Showing the crane hoisting slabs*

### Surface Treatment

The outer layer of ballast concrete makes the wall weatherproof, and the fact that this is cast uppermost on the platform allows it to be readily surface treated. The practice is to scrub this surface about 24 hours after it has been poured



*Walls cast on platforms*

in order to expose the aggregate, and the effect thus produced on these houses at Cambridge is good.

At the corners and at window and door openings the loose breeze core is replaced by ballast concrete, so that at these places there are gravel concrete piers 5½ inches thick to give added strength to the structure. At certain horizontal lines, such as the top of the slab, over window openings, etc., the loose breeze is also replaced by ballast concrete, so that at intervals both vertically and horizontally there are piers and rails of strong concrete, which are reinforced with steel rods.

The usual practice is to use this type of wall for both lower and upper stories, but as the upper part of these houses was to be tile-hung, and there was thus no need for the weatherproof face to the slabs, breeze was used throughout for the walls to the upper stories.

### Method of Erection

When the slabs are poured, iron rods with hooks at the end are embedded in the concrete for lifting purposes, and when they have hardened they are lifted by the crane and placed in position. With ordinary portland cement the slabs are left ten days to harden, but a Cambridge rapid-hardening portland cement was used with the result that it was possible to hoist these large slabs two days after casting.

The first slab erected for each pair of houses is held in position by struts until a slab is placed at right angles, when the system of interlocking lugs by which the slabs are connected is sufficient to hold them vertical without other support. The lower slabs are bedded in mortar on the fottings, while a bed of mortar is placed on the top of these slabs to receive the slabs forming the upper story.

Partition walls are cast in one piece on a platform and hoisted into position in the same way. These are only 2 inches thick of breeze concrete for the upper floor and 4½ inches for the ground floor, an da moving platform is used to prevent breakage during erection. As much as possible of the work is precast and hoisted in this way. Floors and roofs are built of wood in the usual way, as it is found that concrete offers no economy in this direction when applied to this type of construction.

The contract price for these houses, which have a floor area of 937 square feet, is about $2,375, which was considerably lower than competitive tenders for other methods and materials.

John D. Bland, housing architect for the corporation, directed the construction.

*The completed houses*

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## Soap as a Concrete Waterproofer

The effect of soap as a waterproofing material for concrete has recently been investigated in Great Britain and found to be advantageous. For this purpose only a slight addition of soap, amounting to 0.05 per cent of the weight of the concrete to be waterproofed, is necessary. The soap imparts impenetrability to the concrete by reason of its colloidal swelling in the pores on the surface of the concrete. For a successful product, however, it is necessary that the concrete in setting should not be allowed to dry too quickly. In fact, it should be kept damp for at least seven days. This insures no weakening of the concrete, and with the soap addition the strength of the concrete gains slowly after drying. The usual precautions, however, must be taken to prevent cracking of the concrete, as the soap is not effective in preventing the ingress of the water through the cracks.

A very considerable advantage derived from waterproofing arises from the fact that a block of plain concrete wetted on one side expands, and gives rise to internal stresses which tend seriously to diminish the strength of the concrete. The addition of soap, preventing the admission of water, provides some guarantee against this weakening with wetting.

# Design of Deep Circular Bins

## A Concise Presentation of a Practical Method for Designing Deep Bins for the Storage of Materials Such as Grain, Cement, Coal, Etc.—Discussion of Theories Regarding Horizontal and Vertical Pressures in Bins

By W. W. HAY

WHAT small amount of theory pertaining to the practical design of deep bins for the storage of materials of a granular nature, such as grain, cement, coal, building materials, and others as is available in technical literature is found in texts which are largely obsolete. The fundamental analysis of the horizontal and vertical pressures in bins of considerable depth compared to the cross-section is known in American and in English texts as Janssen's Theory; in Continental Europe, as Koenen's Solution. The treatment differs, but the resulting formula is the same, and may be expressed:

$$p = \frac{wR}{fk}\left[1 - \frac{1}{e^{\frac{fkh}{R}}}\right] \qquad (1)$$

where $p$ = vertical pressure at given depth,
$h$ = depth of filling (feet),
$w$ = weight of filling (lbs. per cu. ft.),
$k$ = ratio of lateral to vertical pressure,
$R$ = ratio, area of bin to perimeter of bin,

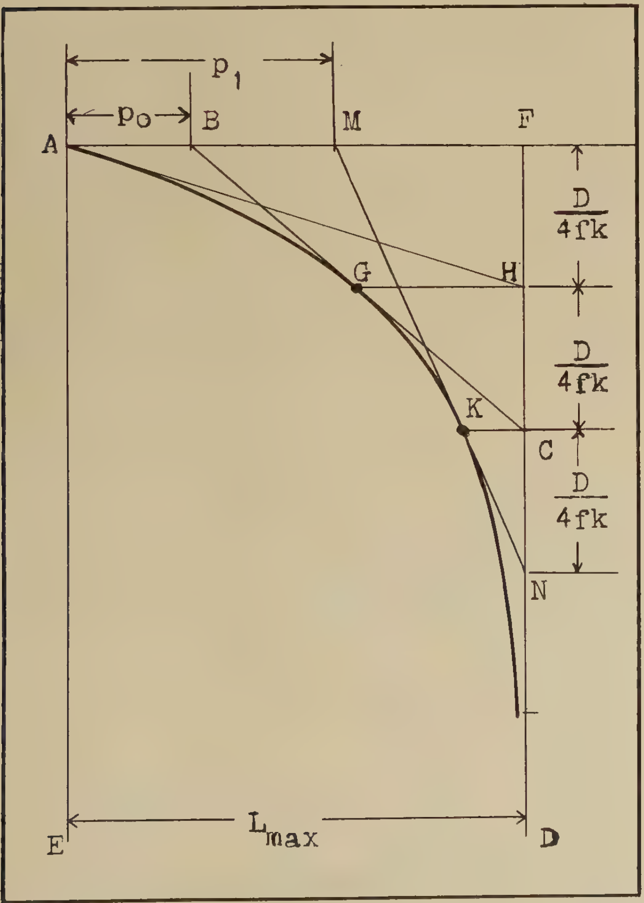

Figure 1.

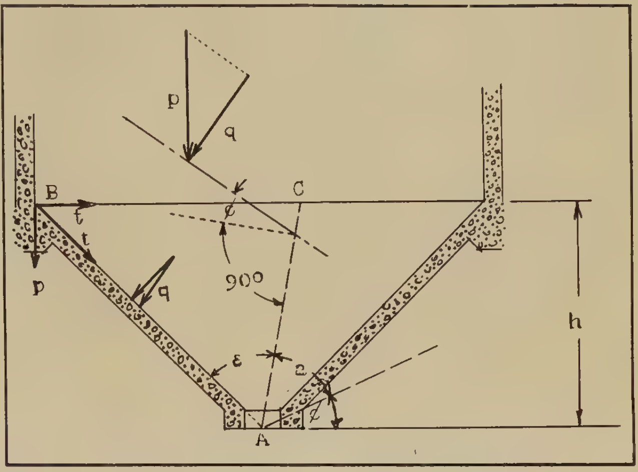

*Figure 2*

$f$ = co-efficient of friction of filling on the bin wall,
$e$ = base of Naperian logarithms = 2.71828;

for round or square bins, $R = \frac{D}{4}$, where

$D$ = diameter or side of bin,

and (1) may be written:

$$p = \frac{wD}{4fk}\left[1 - \frac{1}{e^{4fk\frac{h}{D}}}\right] \qquad (2)$$

The derivation of this formula involves the use of integrals and the full derivation may be found in Ketchum's text.[1]

Note the manner in which we have written (2),—for a given material, the only variable is the quantity $\frac{h}{D}$. The determination of pressures is, fundamentally, calculating values of $p$ at depths $\frac{h}{D}$. Further, at an infinite depth $H$, (2) becomes:

$$P_{\max} = \frac{wD}{4fk} \qquad (3)$$

and

$$L_{\max} = \frac{wD}{4f} \qquad (4)$$

In other words, there is a limit to the pressures, and since practically this limit is approached at comparatively small values of $\frac{h}{D}$, it enables us to simplify considerably the drawing of the pressure curve.

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[1] "The Design of Walls, Bins and Grain Elevators," by Milo S. Ketchum, 2nd Ed., pp. 307-309.

Table I is a tabulation of the values used by various designers for the functions of the equation:

TABLE I

| Material | Weight Lbs. per cu. ft. | Values of $k$ | Values of $f$ |
|---|---|---|---|
| Wheat | 50 | 0.60 | 0.40-0.43 |
| Gravel, bank | 105-110 | 0.22-0.33 | 0.45-0.60 |
| Gravel, screened | 110 | 0.23 | 0.60-0.75 |
| Stone, crushed | 100-110 | 0.22-0.31 | 0.84 |
| Sand, screened | 100-105 | 0.33 | 0.58 |
| Sand, bank | 80-110 | 0.22-0.31 | 0.40 |
| Coal, anthracite | 52-56 | 0.38 | 0.51 |
| Coal, bituminous | 45-55 | 0.17 | 0.70 |
| Cinders | 40-45 | 0.22 | 0.84 |
| Cement | 84-92 | 0.22 | 0.55 |
| Clinker | 95 | 0.29-0.40 | 0.47-0.55 |
| Lime | 50-55 | 0.13 | 0.55 |
| Minerals | 100-175 | 0.17 | 0.58-0.84 |

The calculation of the pressure at various depths is a tedious operation and the following method of developing the curve of pressures is sufficiently accurate for all practical purposes. Using selected values for $w$, $k$, and $f$, dedetermine the limiting value for the lateral pressure $L_{max} = \frac{w}{4f}D$ and draw the approximate curve of pressures as shown in Figure I.

Referring to Figure 1, let $AF$ and $AE$ be the co-ordinates for lateral pressure and depth; draw $FD$ parallel to $AE$ so that $ED = L_{max}$; lay off $FH = HC = CN = \frac{D}{4fk}$; lay off on $AF$ the distance $p_o = 0.264\ L_{max}$ and connect $B$ and $C$; lay off $p_1 = 0.594\ L$ and connect $M$ and $N$; locate the points $G$ and $K$ by intersection. The points $G$ and $K$ are on the true pressure curve, which may be drawn from $A$, tangent to $AH$, tangent to $BC$ at $G$, to $MN$ at $K$, and approaching $FD$ as a limit.[2] The relative depth at which this curve becomes practically parallel to $FD$ and touching it is at $\frac{D}{fk}$, for which value the calculated pressure will be over 98 per cent of the ultimate pressure from (4).

The resulting curve is certainly sufficient for all practical purposes, since there is a choice in the selection of values for $w$, and $k$, or $f$. Having drawn the relative pressure curve for the given material, it may be converted into a curve for any diameter by proportion, and further, into a curve of bursting pressures by means of the expression $T = \frac{LD}{2}$. Hence, if we multiply the pressure ordinates of the curve by the quantity $\frac{D^2}{2}$ we get directly a table or curve of bursting strains at various ratios of depth $\frac{h}{D}$. A curve of steel areas can then be superimposed and the spacing of rods or cross-sections may be read direct from the curve.

For many years it was customary to form the bin bottom by filling, the prime consideration being to provide a hoppered slope that would be self-cleaning. Of late there is an increasing tendency to return to the suspended hopper bottom, with consequent increased storage in a given height, and the following simple method of calculating the pressures on such a bottom is offered as easy of application and eminently practical:

Referring to Figure 2, the total load on the hopper bottom is

$$W = A \cdot P_{max} + A \cdot \frac{h}{3} \cdot w + \text{the dead-load of the bottom}$$

and the tension along the edge of the bin is $p = \frac{W}{P}$, which may be resolved into its components

$t'$, tension at the junction of slabs, or in the cone;

$t''$, parallel to the bottom at the junction with the bin walls. The pressure due to the prism of rupture along $CA$ is $p' = BC(p + \frac{h}{2} w)$ (for bottom of 45 degree slope) which may be resolved into a pressure $q'$ (by Coulomb's Theory). Now, due to greater intensity of the pressure $p$, from the filling in a deep, narrow bin, over that due to the small prism $(BC \frac{h}{2})$, we can assume the pressure due to the internal sliding as a uniform pressure over the entire slab under consideration, and

$$q'' = \frac{q'}{h/2}, \text{ parallel to } q'.$$

This may be resolved into a pressure $p''$, normal to the slab, producing bending in the bin-bottom slab.

A rapid approximation of the soil pressures from a nest of circular bins may be had by allowing about 500 lbs. per sq. ft. for the dead-weight of basement, bin-bottom slab, and cupola; calculate the amount of concrete in the bin walls by

$\frac{1.5}{D}$ cu. ft. concrete per hor. sq. ft. per vertical foot for 6-inch bin walls;

$\frac{1.7}{D}$ cu. ft. concrete per hor. sq. ft. per vertical foot for 7-inch bin walls;

add to the dead-weights as above the weight of the filling, and the sum will be sufficiently close to the actual loading to permit a study of foundations without actually laying out and detailing the structure.

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[2] Proof:

Put $h_o = \frac{D}{4kf}$, whence $\frac{h}{D} = \frac{1}{4kf}$, and equation (2) becomes

$$l_o = \frac{wD}{4f}(1 - \frac{1}{e}) = L_{max} - \frac{L_{max}}{e}$$

and

$$BF:GH = CF:HF = 2h_o:h_o,$$
$$BF = 2GH$$

also

$$GH = L_{max} - l_o = \frac{L_{max}}{e}$$

hence

$$BF = \frac{2L_{max}}{e}$$

then

$$\begin{aligned} AB = AF - BF &= L_{max} - \frac{2L_{max}}{e} \\ &= L_{max}(1 - \frac{2}{e}) \\ &= L_{max}(\frac{0.71828}{2.71828}) \\ &= 0.264\ L_{max} \end{aligned}$$

In a similar manner, $AM = 0.594\ L_{max}$.

# Advantages of Quick-Hardening Cement

## A Discussion of the Several Methods of Securing High Early Strength Concrete for Pavement Construction

By H. S. MATTIMORE

ANY construction materials or methods of operation which would reduce inconvenience and delays of traffic in congested areas are an advantage. If the customary curing period for concrete pavements and bases can be reduced by the use of a special cement, or by increased cement content and a decrease of the water content in the mix, the main subject for discussion is—which method is the most economical and gives the best service value.

Special cements used for the purpose of obtaining high early strength concrete are of two general types—high alumina cement and special portland cement.

### High Alumina Cement

This product was first manufactured on a commercial basis in France in 1912. It was very little known in America until reports were received relative to its use in the world war. It differs greatly in chemical composition from portland cement, in that there is a much larger alumina content and a lower lime and silica content. Although the composition differs greatly from the standard portland cement, the setting time is practically the same, which allows it to be mixed and placed in the same manner as the ordinary concrete, but due to the high temperatures developed during the accelerated hardening period, great care must be taken in curing high alumina cement concrete. Applications of water at too early stages, either by sprinkling, ponding or covering with wet burlap, which is the usual practice in curing portland cement concrete, are detrimental to resulting quality in the high alumina cement concrete.

These are closely related in composition with the standard portland. Quick-hardening properties depend on careful selection of raw materials, fine raw grinding, thorough burning and very fine grinding of the clinker. Also, some of these cements show especially high lime content. Tests available demonstrate that many of these special portland cements produce high early strength concrete, but not equal to some of the high alumina type at the 24 or 48 hour periods.

### Rich Mixtures and Low Water Content Method with Normal Portland Cements

Another method for producing high early strength concrete is by the use of increased cement content, and decrease of the water content in the normal portland cement concrete. Many reports are available relative to the use of this method in obtaining high early strength concrete in base and paving patches, and some few cases are cited where it was used on new construction. The strengths obtained are considerably higher than those where the normal mix and ordinary water content are used, but not comparable in value with concrete paving with high alumina or special portland cements.

In comparing these different methods, if we are selecting on the basis of cement strengths at early ages, both the high alumina and special portland cement concretes show a considerable advantage over the rich mix and low water content concrete, but the solution requires consideration of other factors. The main one, of which there is some positive assurance, is that the use of these special cements produces a concrete as durable as the normal portland cement. The limited amount of long time test data available on these products indicates a tendency toward retrogression in strength after the six months period. This indication has a tendency to make us cautious in the use of the products on important projects. Another factor which deserves consideration is that in the special portland cements, claims are made that the percentage of tricalcium silicate is increased to an extent where the hardened cement is more soluble in water. This would have a considerable effect on durability under some conditions.

A point very pertinent to this discussion is that one rather comprehensive series of tests on concrete, reported by the Committee on Materials of the American Association of State Highway Officials, demonstrates conclusively that the tensile strength of portland cement used in normal concrete has a direct relation to the transverse and compression strength of such concrete. This is a matter of general information to engineers specializing on materials, but very little advantage can be taken of it under the present standard cement specifications, where minimum strengths are specified for quality determinations. This difference in strength at early ages, in normal portland cement, is an important point for consideration where the rich mix and low water content method is used to obtain early hardening concrete.

### Conclusions

From personal experience and data available on this subject to date, I would not feel justified in recommending the use of quick-hardening cements as a class for use on important work. There is no doubt that the quick-hardening qualities are effective in producing early hardening concrete, but such factors as durability in service and the stability of the product in normal storage are still in doubt. Also, in aiming to meet the demand for special portland cements, there may be a tendency to overlime the material to a stage resulting in an unstable product. If it is essential to use a brand of quick-hardening cement, careful investigation should be made relative to the method of production, and what has been its durability in actual service tests.

The safest procedure at the present time, to obtain early high strength concrete for pavements and bases, is by a combination of richer mixes, low water content, and thicker slabs. This method has been used to a limited extent by the Pennsylvania State Department of Highways, on some important intersection surfacing and patching, and has given satisfactory service under heavy traffic for a period of nine or ten months. This concrete was proportioned 1:1½:2½ with 4 gallons of water per bag of cement. Some of the quick-hardening cements were used in concrete, in this same location, and had to be replaced within a year after laying.

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Presented at a meeting to discuss co-ordination of the construction and maintenance of roads and streets held at the Engineers' Club of Philadelphia, March 2, 1928.

# *Procedure for the Analysis of Cinder Concrete*

By J. L. HEITZMAN
Engineer of Tests, E. L. Conwell & Co.

THE following method of analyzing cinder concrete has been found very satisfactory. To proceed, first take a sample of concrete, weighing from five to ten pounds, which is thoroughly representative of the concrete under observation. This should be dried and then crushed to pass a ¼-inch screen. If the sample is wet, it can be dried in an iron pan, the temperature being regulated so as to prevent burning the coke of the cinders. The large sample is then reduced by quartering or through a riffle to one pound. This is called Sample A. From this is taken a smaller sample of about two ounces which is pulverized and called Sample B.

### Cement

Weigh accurately one gram from Sample B, transfer it to a 200 c.c. beaker, add 30 to 50 c.c. of HCL (1-9), warm on a hot plate until all soluble matter is in solution, filter and wash thoroughly with small amounts of hot water. Then dry the filter paper and residue to constant weight at 100 deg. C. The residue, after drying, may be brushed directly on the balance pan, the small amount adhering to the paper usually being disregarded. The weight of this insoluble matter multiplied by 100 gives the percentage of sand and cinders present in the concrete.

Next evaporate the filtrate to complete dryness as in silica determinations. Then cool it, add 20 c.c. of HCL (1-1), warm until the iron is in solution, dilute to 50 c.c. with water, bring to boiling, filter, wash thoroughly, ignite and weigh. The weight obtained multiplied by 500 gives the percentage of cement in the sample.

### Sand and Cinders

Weigh 50 grams from Sample A and add 100 c.c. of HCL (10 per cent). Warm this until the soluble matter is in solution, filter, wash once or twice by decantation. Then filter it thoroughly. Hot water is best for washing and the filtering is best accomplished by using a large funnel and filter paper of a large size.

The filtrate may be discarded. The residue is transferred to a large evaporating dish and the cinders removed from the sand by elutriation, using Thoulet's solution as the separating medium. Best results are obtained by covering the residue of sand-cinders with the iodide solution, stirring for 15 seconds, then allowing 15 seconds for the sand to settle. Then pour the liquid and floating cinders into another dish or beaker. The sand is treated in this manner several times until no cinders are present. It is then washed once or twice by decantation, then on the filter until free from iodide solution, dried at 100 deg. until constant weight is obtained. The weight obtained, multiplied by 2, gives the percentage of sand in the sample.

At the same time, the separated cinders are filtered from the iodide solution and the latter is returned to the stock bottle for future determinations. When the last of the iodide solution has passed through the funnel, the filtrate is removed and the cinders are washed thoroughly as in the sand determination. The cinders are then dried to constant weight and the weight obtained multiplied by 2 gives the percentage of cinders. To shorten the work, the percentage of sand may be obtained by the difference between the percentage of cinders and the percentage of the total insoluble matter found in Sample B.

### Remarks

Thoulet's solution is made of such a strength that cinders will float while sand settles to the bottom of the dish or beaker. It may be made up as follows:

240 grams of mercuric iodide and 200 grams of potassium iodide are thoroughly mixed on a paper, then slowly added to 150 c.c. of distilled water. When all is dissolved, obtain the specific gravity and dilute if necessary until the latter is 2.4 to 2.5. This solution may be varied as to specific gravity so that slag may be separated from cinders or sand, but since the composition of slag is so variable, no set rule can be made for its determination.

Thoulet's solution is expensive, but can be used continuously if care is taken that no water is added during the analysis. It may be strengthened by adding the iodides mixed in the proportions of 1.2 parts mercuric iodide to 1.0 part potassium iodide.

Best results are obtained in this separation if coarse material is used. There may be a small percentage of cinders carried down with the sand, but as some of the sand is carried over by the elutriation, the errors tend to balance each other. Fused iron pyrites, a common constituent of cinders, would settle with the sand, while clay and silt would be carried over with the cinders.

To change parts by weight to parts by volume, divide the parts by weight of cinders by 45. The weight per cubic foot of sand and cement is practically the same, hence no change is necessary, but a cubic foot of cinders weighs from 40 to 50 pounds, so that one part by weight of cinders would be slightly more than two parts by volume.

The soluble silicate obtained in Sample B represents the silica of the cement. This amounts to about 20 per cent, hence the result multiplied by 5 represents the percentage of the cement.

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## All-Concrete Airports Possibility

The first concrete runway of consequence for the landing and taking off of airplanes is now under construction at the Ford airport near Detroit. It will be 75 to 125 feet wide and 3,000 feet long.

Permanent airports with fireproof concrete hangars, paved parking areas for planes and long concrete runways for take-offs and landings easily seen at night are rapidly becoming recognized as a necessity in nearly every American city, according to a survey made by the Portland Cement Association.

Turf and cinder airplane landing fields are not now as practical as they might be and would not stand the wear imposed by the landing and taking off of planes carrying as many as thirty persons and freight planes carrying eight or ten tons, such as are to go into service shortly between Chicago and Los Angeles, thus opening a market for concrete airports.

# *Organizations*

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth St., New York City.

American Road Builders' Association; Miss E. A. Birchland, Secretary, 29 W. Thirty-ninth St., New York City.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. Annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 25th to 29th.

Associated General Contractors of America; D. H. Sawyer, Secretary, 1150 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; Wharton Clay, Commissioner, 123 W. Madison St., Chicago.

Association of Cast Stone Manufacturers; Frank M. Brooks, Secretary, Pasadena, Calif.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Concrete Products Association; F. O. Matthiessen, Secretary, 644 Drexel Building, Philadelphia, Pa.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Iowa Concrete Products Association; Floyd Goodrich, President; R. L. Gavin, Secretary-Treasurer, 405 Hubbell Bldg., Des Moines, Iowa.

National Association of Building Trades Employers; A. E. Coleman, President; A. W. Dickson, Executive Secretary, 2226 Builders Building, Chicago, Ill.

National Association of Builders' Exchanges; William F. Chew, Baltimore, President; Earl F. Stokes, Secretary, 15 E. Fayette St., Baltimore, Md.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 E. Twenty-second St., New York City.

The National Lime Association; G. B. Arthur, Secretary, 927 Fifteenth St., N.W., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 933 Leader-News Building, Cleveland, Ohio.

Northwest Concrete Products Association; F. R. Zaugg, Executive Secretary, 803 Seaboard Building, Seattle, Wash.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; E. B. Bushnell, Secretary-Treasurer, 425 E. Water St., Milwaukee, Wisconsin.

# Mixer Musings

Reported by "Joe"—The Mixer Boss.

## In the Spring Even a General Superintendent's Fancy Turns to Thoughts of—

CONCRETE,
Chicago, Ill.

Dear CONCRETE:

When a general superintendent gets to trying poetry you know he's beginning to get nuts, but this one has done so. Consequently I'm offering no apologies.

If you can't use it send it back.

We like it.

Sincerely,

(Signed) PAT O'LEARY,
*Superintendent for W. T. Hadlow.*

*Come, Gentlemen, and listen to a tale you seldom hear,*
*Of chains and cogs and grinding, day and night.*
*It is the noise of giants but you need not have a fear,*
*For they lead us out of darkness into light.*
*Production is their watchword and mighty is their goal*
*And silently they work for you and me,—*
*I'm speaking of the builders whose tale has not been told,*
*Their monuments, though, stretch from sea to sea.*

*The mixture of their cement, their sand and rocks complete*
*Produce before your wondering eye the stuff that's called*
CONCRETE.

*You drive along your boulevards, your streets are smooth and true,*
*You glory in the speed with which you go.*
*The magic that produced them is not enchantment new,*
*But the many years of silence made them so.*
*The toiler in the wilderness, the builder of the plains,*
*The breed has lived for centuries before,*
*But of the man these works, the only testament remains,*
*In profound silence he has gone, he's passed beyond the Door.*

*With struggles with the elements their history is replete,*
*From North and South and East and West, they built with one*
CONCRETE.

*That mass of steel and stone that stands triumphant over there,*
*Was pioneered by one of brain and brawn.*
*That slender spire a-glistening in sunlight bright and fair,*
*Was born from labor stern, worked dawn to dawn.*
*That massive buttress standing against the water's might,*
*Would never have been seen upon the earth,*
*Without a brain to guide it, without a heart to fight.*
*Perhaps from that you know just what it's worth.*

*A boon to life and toilers strong, that is its one conceit,*
*You surely know just what I mean for simple is its name,*
CONCRETE.

*—PAT O'LEARY.*

***Joe,*** the Mixer Boss.

# New Equipment and Materials

## Testing Sieve Eliminates Sharp Inside Corners

The Newark Wire Cloth Company, Newark, New Jersey, has recently developed a new testing sieve which is equipped with an improved joint. The inside corner is rounded instead of sharp, doing away with filling up of material, the manufacturers say. All soldering is done on the outside.

When replacement becomes necessary, the old solder may be melted off and a new piece of cloth soldered on.

These sieves are made in 3-, 5-, 6-, 8-, 10-, and 12-inch diameters and in accordance with U. S. Bureau of Standards specifications, adopted as standard by the American Society of Testing Materials in 1926.

## New Curing Agent Known as Curcrete

The Barber Asphalt Company, Philadelphia, Pennsylvania, has developed "Curcrete" for curing concrete. This is an asphalt emulsion used in curing concrete highways, foundations, sidewalks, floors, platforms, bridge and roof decks, and other flat slab surface construction.

Curcrete is an asphalt emulsion applied to newly finished concrete by a sprayer. The continuous glossy film effected is designed to prevent the evaporation of water.

The Curcrete method is claimed to result in a more uniformly cured slab of increased strength. In application, it presents a continuity of film easily evident.

## New Machine for Shingle Roofing Tile

The Crawfordsville Machinery Company, Indianapolis, Indiana, is now on a production scale and ready for the market with its new roofing shingle and power percussion press.

In manufacturing the tile, the 1/16-inch color topcoat is compressed into the body of the tile by a total pressure of 200 tons, and the manufacturers continue, the tile as a whole receives a pressure equal to hydraulic pressed floor tile. Sand, Haydite, or asbestos may be used.

The machine is designed to make a flat shingle design of tile, with a uniform cross section thickness easy to cut for hips and valleys. The machine has a capacity of 20 squares a day.

## New Size of Ingersoll-Rand Air Compressor

The Ingersoll-Rand Company, New York, has added a new size, having a 4¾-inch bore by 4-inch stroke, to its line of portable air compressors. It has a piston displacement of 82 cubic feet per minute, and is intended for uses requiring units of slightly larger capacity than the 4¼-inch by 4-inch 60 cubic foot machine.

In equipment it is similar to other compressors of this manufacture.

## Improved Gasoline Engines

Fuller and Johnson industrial engines, while not strictly new equipment, are worthy of mention in these columns because of the new improvements and features being made and added. Two recent changes are the solid disc fly wheels designed to increase their smooth running qualities and the gib key shroud, promoting safety for the operator.

The 1½, 2, and 2½ h.p. sizes may be mounted on steel channel iron skids. Their height may be varied, using 3-, 4-, or 5-inch channels which are available in practically any length desired and may be attached with the angles facing in or out.

The gasoline filler pipe is placed at such an angle that the operator may easily insert a measuring rod. A threaded pipe cover prevents loss of gasoline due to tilting or jarring.

## *Incor, 24-Hour Portland Cement, Now Available*

The International Cement Corporation announces a new product, a portland cement which produces concrete ready to use in 24 hours. It is a true portland cement said to contain no admixtures. The new product, which has the copyrighted name Incor Cement, is made by a special process, upon which the chemists and production staff of the International Cement Corporation have been engaged for the past five years. Following laboratory tests, the product was manufactured in limited quantities while exhaustive field tests were carried forward under the supervision of Professor Duff A. Abrams, director of research of the International Cement Corporation. The new product is now on a quantity production basis.

Incor is a "perfected portland cement" because it has precisely the same characteristics as "portland cement" as defined by the Standard Specifications of the U. S. Government and the American Society for Testing Materials, with the additional quality of producing 24-hour concrete, the International corporation says. In announcing this new product, H. Struckmann, president of the International Cement Corporation, stated that among other important projects in which Incor cement has been used is the Moffat tunnel, recently opened west of Denver, Colorado.

In brief, Mr. Struckmann's statement said:

"The International Cement Corporation has for some time recognized the demand for a cement that would make possible a 24-hour concrete but we never believed it safe to enter unknown fields through the manufacture of cement of a composition different from portland cement.

"Our chief chemist and his assistants have worked at the problem for years, constantly experimenting and constantly seeking a method for producing a portland cement without admixture that would answer the demand and at the same time have the assured permanency of portland cement.

"The result is Incor cement. Incor is a perfected portland cement developed through special treatment but without the use of admixtures of any kind to a point of efficiency and high early strength that renders practical the ideal of 24-hour concrete. The name Incor is a contraction of the name International Cement Corporation, and has been copyrighted. Patent applications on the process are pending.

"This product approaches the ideal tricalcium silicate composition so long sought by chemists and in use develops the same general characteristics and may be used under the same general instructions as portland cement; but because of its increased efficiency the resulting concrete may be used in 24 hours. It is not a new or untried material—it is a true portland cement and can be used with the same assurance of permanency as may be expected from that well-tried material."

# A Background of Diversified Use

SKYSCRAPERS, reservoirs, power plants, elevators, athletic stadia, institution buildings, bridges — whatever the type or purpose of the structure— there is precedent of years standing recommending the use of rail steel bars for all concrete reinforcement.

**Rail Steel Bar Association**

**Builders Building • • Chicago, Illinois**

Buffalo Steel Company, Tonawanda, N.Y., Pollak Steel Company, Cincinnati, Ohio, Missouri Rolling Mill Corp., St. Louis, Mo., West Virginia Rail Co., Huntington, W. Va., Connors Steel Company, Birmingham, Ala., Calumet Steel Company, Chicago, Ill., Laclede Steel Company, St. Louis, Mo., Franklin Steel Works, Franklin. Pa., Canadian Tube & Steel Prod., Ltd., Montreal, Quebec, Burlington Steel Company, Hamilton, Ontario.

RAIL STEEL REAL STRENGTH

# RAIL STEEL

# About Makers of Equipment and Materials

## INDUSTRIAL LITERATURE

### *Blaw-Knox Form Book*

A recent new publication received from the *Blaw-Knox Company*, Pittsburgh, Pennsylvania, and known as *Bulletin 1024*, contains complete data on steel street forms for curb, curb and gutter, integral curb and sidewalks. Some space is devoted to steel dividing plates and radius forms.

Photographic illustrations are plentiful and are accompanied by numerous diagrams.

### *New Smith Mixer Catalog*

*The T. L. Smith Company* of Milwaukee, manufacturers of Smith mixers and pavers, are distributing a new 72-page catalog covering their full line.

Included in the catalog are eleven full page views in color showing Smith mixers in service on some of the outstanding construction projects such as the Cascade tunnel, Jordan dam, Goodrich tire plant, Exchequer dam, Chicago sewage disposal plant and the Memorial bridge at Gadsden, Alabama. Other pages are devoted to the description of the various sizes from the small 2½ cubic foot mixer to what is said to be the world's largest mixer with a batch capacity of 4 cubic yards.

The patented Smith end-to-center mixing action is fully described as are other structural features.

## Notes from the Field

### *Anchor Distributor*

*Paul E. Jackson* has been appointed distributor of *Anchor* concrete products plant equipment in New England territory. Headquarters are at 2 Kingsbury Street, Worcester, Mass.

### *Larger Manufacturing Quarters*

*The Stuebing Cowan Company* of Cincinnati, Ohio, and Holyoke, Miss., have moved their New England plant into larger quarters.

The increased demand for *Stuebing Cowan* lift trucks and platforms necessitated this move, and now permits the Holyoke factory to take care of all New England and eastern business with an 80 per cent increase in floor space.

A complete stock of standard model lift trucks is carried at Holyoke for prompt shipment to all eastern points, including territories as far south as Baltimore and Washington.

### *Abram Equipment*

*The Abram Cement Tool Company,* Detroit, Michigan, presents to concrete products manufacturers in a new publication entitled *"Blue Ribbon Blockmaker Supreme,"* fourteen points of original design in the Abram Blue Ribbon mold box. A view of the machine illustrating each point is shown.

An outline of the ten exclusive features of the Abram Blue Ribbon power tamper follows.

### *Ideal Stripper*

The *Ideal* self-contained vertical power stripper is described in a four-page folder issued by the *Consolidated Concrete Machinery Corporation,* Adrian, Michigan.

According to the folder the stripper is "a big capacity production unit for the economical manufacture of concrete blocks and tile, embodying seven important advantages."

### *Portable Compressor Book*

*Ingersoll-Rand Company,* New York City, has just completed the sixth edition of its 140-page, two-color book entitled, "100 *and* 1 *Ways to Save Money with Portable Compressors."* In this book the company has embodied comparative cost data on its portable air compressors and air-operated tools (rock drills, paving breakers, clay diggers, backfill tampers, grinders, hoists, riveting hammers, chippers, metal drills, etc.) The information has been put together in handy-reference, cross-index form. In most cases, figures are presented on a man-hour basis.

### *Milcor Manual*

*The Milwaukee Corrugating Company,* Milwaukee, Wisconsin, has now completed the publication of the latest edition of the Milcor Manual, No. 20-E, containing 96 pages. The four different types of *Milcor* metal lath are shown and discussed. Each type has definite uses and these are taken up in detail in this new book.

A 10-page section devoted to solid partitions on metal lath is a new addition. It contains entirely new information on the erection of solid partitions and the advantages of this type of construction. Detailed drawings help to clarify the points brought up.

New *Milcor* products in the fireproof material line are described in detail. They include a new clip for fastening rib lath to I-beams, a concrete joist insert for fastening attached or suspended metal lathed ceilings to concrete joists, a new "Expansion" corner bead with one narrow wing, *Milcor* corner lath, a coping cutter for bull nose "Expansion" corner bead, and a complete line of metal window stools, chair rails, cove bases, chalk trough and blackboard trim.

### *On Traffic Knots*

An interesting and informative booklet entitled *"Cutting the Traffic Knot"* has just been published by the *Universal Portland Cement Company.*

It is a compilation of data issued by a number of state highway departments, experiment stations, and an automobile chamber of commerce on traffic congestion and suggested remedies.

### *"Plain Talk About Concrete Floors"*

The results of a survey undertaken for the purpose of determining the relative efficiency of different types of floor finish over years of actual industrial plant use are published in a booklet called, *"Plain Talk About Concrete Floors."* The investigations were made among industrial plants regarding the actual costs of installing and maintaining concrete floors.

The Ohio State Engineering Laboratories have co-operated in determining the facts presented, by means of extensive laboratory tests of cement floor finishes, the results of which are given in detail. An interesting and important parallel between the laboratory findings and the results disclosed by the survey of actual plant floors points to certain definite conclusions regarding installation methods that will be of invaluable help to everyone interested in floor construction.

*"Plain Talk About Concrete Floors,"* which has less than 40 pages, carries over 50 illustrations and contains specific facts and figures. Data shown have been obtained from owners on initial costs and maintenance costs. No space is wasted in pointless generalities; reading time is 20 minutes.

The book is published by *The Master Builders Company,* Cleveland, Ohio.